California High-Speed Rail Authority

RFP No.: HSR 14-32

Request for Proposals for Design-Build Services for Construction Package 4

Reference Material, Part C.10 Preliminary Design Baseline Report

Note: Southern limit of CP4 ends just north of Poplar Ave, at approximately station WS1 5880+00, even though this document shows the limit just north of 7th Standard Road. Work south of the contract limit of WS1 5880+00 should not be considered as part of the contract

CALIFORNIA HIGH-SPEED TRAIN

Engineering Report

15% Record Set Design Submission

Fresno to Bakersfield

Design Baseline Report

June 2014

RFP No. HSR 14-32 – INITIAL RELEASE - 05/27/2015

CALIFORNIA
High-Speed Rail Authority

California High-Speed Train Project Engineering

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Fresno to Bakersfield
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Prepared by:

URS/HMM/Arup Joint Venture

June 2014

Table of Contents

Page

Appendices

Tables

Figures

List of Abbreviations and Acronyms

AASHTO	American Association of State Highway and Transportation Officials
Authority	California High-Speed Rail Authority
BNSF	BNSF Railway
BMP	best management practices
Caltrans	California Department of Transportation
CAM	Constructability Assessment Memorandum
CASQA	California Stormwater Quality Association
CESA	California Endangered Species Act
CEQA	California Environmental Quality Act
CIDH	cast-in-drilled-hole
CDFW	California Department of Fish and Wildlife
CIP	cast in place
CGC	California Government Code
CVFPB	Central Valley Flood Protection Board
DBR	Design Baseline Report
DEIR	Draft Environmental Impact Report
DEIS	Draft Environmental Impact Statement
DTM	Digital Terrain Model
DWR	California Department of Water Resources
EIR	Environmental Impact Report
EIS	Environmental Impact Statement
EPA	United States Environmental Protection Agency
FB	Fresno to Bakersfield
FEMA	Federal Emergency Management Agency
FMFCD	Fresno Metropolitan Flood Control District
FRA	Federal Railroad Administration
GIS	geographic information system
HDM	Caltrans Highway Design Manual
HMF	heavy maintenance facility
HSR	high-speed rail
HV	high-voltage
H:V	horizontal-to-vertical ratio

ISR	indirect source review
KRCD	Kings River Conservation District
KTR	Kings/Tulare Regional
kV	kilovolt
MOIF	Maintenance of Infrastructure Facility
MOIS	Maintenance of Infrastructure Siding
MOU	Memorandum of Understanding
mph	miles per hour
NEPA	National Environmental Policy Act
NHPA	National Historic Preservation Act
NOD	notice of decision
NPDES	National Pollution Discharge Elimination
O&M	operations and maintenance
PG&E	Pacific Gas and Electric Company
PMT	Program Management Team
PPDG	Project Planning and Design Guide
PPMRP	Pollution Prevention and Monitoring and Reporting Plan
PS	Paralleling Station
PS/PC	prestressed/precast
RC	Regional Consultant
ROD	Record of Decision
RWQCB	Regional Water Quality Control Board
SJVUAPCD	San Joaquin Valley Unified Air Pollution Control District
SR	State Route
SRS	stand-alone radio sites
STA	station
STB	Surface Transportation Board
Stoil	former Standard Oil
SWPPP	Stormwater Pollution Prevention Plan
SWRCB	State Water Resources Control Board
SWS	Switching Station
TCE	temporary construction easement
TDC	targeted design constituent
TM	technical memorandum(a)

TOR	top of rail
TPF	traction power facility
TPSS	traction power substation
UPRR	Union Pacific Railroad
URS/HMM/Arup Joint Venture	URS/HMM/Arup
U.S.	United States
USACE	United States Army Corps of Engineers
USFWS	U. S. and Wildlife Service
WSE	water surface elevation

Executive Summary

Executive Summary

The California High-Speed Rail Authority (Authority) proposes to construct, operate, and maintain the California High-Speed Train Project, an electric-powered passenger high-speed rail (HSR) system in California. When completed, the approximate 800-mile rail system would connect the major metropolitan areas of California, extending from San Francisco and Sacramento in the north to Los Angeles and San Diego in the south. The route of the HSR would be secure and grade-separated, meaning no at-grade vehicle or pedestrian crossings of the HSR tracks and access to the HSR infrastructure limited to only authorized persons at all times.

The Fresno to Bakersfield (FB) Section of the HSR system would span approximately 114 miles, extending from Stanislaus Street in Fresno to approximately King Street in Bakersfield. [1] This section includes proposed HSR stations in downtown Fresno and Bakersfield, and at a site east of Hanford, known as the Kings/Tulare Regional (KTR) Station. Alternative alignments for the FB Section have been evaluated in an Environmental Impact Report/Environmental Impact Statement (EIR/EIS), which analyzed the environmental impacts and benefits of implementing those alternative alignments between Fresno and Bakersfield. The EIR/EIS guided the identification of a preferred route within the corridor, which was subject to further environmental analysis. The Final EIR/EIS identifies a preferred alignment and stations for the HSR between Fresno and Bakersfield.

The proposed FB Section preferred end-to-end alternative comprises a subsection through downtown Fresno adjacent to the existing Union Pacific Railroad (UPRR) and then turns southwards to parallel the BNSF Railway (BNSF) south of Fresno. It would continue southeast over the Kings River Complex and bypasses Hanford to the east prior to briefly rejoin the BNSF alignment east of State Route (SR) 43. The alignment would continue, bypassing Corcoran to the east, and then parallels the BNSF and SR 43 alignments to the west. The alignment would then bypass Allensworth to the west and run adjacent to the BNSF again through the centers of both Wasco and Shafter. After crossing under the Rosedale Highway (SR58), the preferred alternative would turn east towards downtown Bakersfield on elevated structure. Relocating and reconstructing portions of the BNSF railway would be necessary to accommodate HSR right-of-way together with relocating spurs and sidings serving existing freight railway customers.

The majority of the HSR route would be "at-grade" which generally consists of embankments 6 to 10 feet above the surrounding ground. The alignment would include a number of elevated sections for the HSR to cross over existing roadways; railroad main lines and spurs, such as the BNSF and the San Joaquin Valley Railroad; and watercourses, such as the Kings River Complex, Cross Creek, and the Kern River, including their designated floodplains. The heights of the proposed HSR elevated crossings were determined by the requirement to maintain defined clearances above roadways, railroads, and flood control levees. There are no tunnels between Fresno and Bakersfield, and the only location on the Preferred Alternative where the HSR would be below the existing grade in a short segment in the City of Fresno where the HSR passes underneath the East Jenson Avenue Bypass. Where the HSR would be at-grade, existing

[1] The southern terminus of the Fresno to Bakersfield Section is the southern end of the station tracks, which is roughly at King Street for all three Bakersfield alternatives. The analysis of project impacts was extended an additional 2.5 miles to Oswell Street because Oswell Street marks the location where the range of alternatives considered for the Fresno to Bakersfield and Bakersfield to Palmdale sections merge, forming a logical point for the identification of alternatives that would cross downtown Bakersfield. As a result, the preferred alternative discussed in this report would be 117 miles.

roadways generally would be elevated to cross over the tracks. The minimum clearance above the HSR tracks to the undersides of roadway overcrossings was determined by the need to provide sufficient clearance for the overhead contact system that supplies electricity to the electric-powered passenger train sets.

The KTR and Bakersfield stations would be located where the HSR system is elevated. Therefore, all boarding platforms would be elevated as well; whereas the station buildings, ticketing facilities, parking lots, and other ground transportation are at ground level. Passenger access to the elevated platforms would be by means of escalators, elevators, and stairways. The proposed station at Fresno would be at ground level; therefore, both the platforms and the passenger facilities would be at the same level. Passenger access from one side of the station to the other would be via a footbridge, which would be equipped with escalators, elevators, and stairways. Station track layouts would comprise a main line through track plus a station track and storage track for each direction of travel.

The minimum level of preliminary engineering required to support the EIR/EIS process is provided in a series of technical memoranda (TM) issued by the Authority. Overall guidelines for the scope of the preliminary design (referred to as 15% design) are presented in TM 0.1 rev 3 *15% Design Scope Guidelines*, dated December 24, 2013. This TM defines the design elements, development level, and engineering outputs, with the objective of providing a consistent approach in developing preliminary engineering documents to a level that supported the identification of an inclusive environmental envelope—horizontal, vertical and temporal, adequate environmental consequence analyses, permitting, coordination of utility relocation and extension, right-of-way acquisition, and compliance with applicable state and federal regulations. Additional engineering may be required to address risks related to utilities, right-of-way, railroad, water crossings, and concerns of local agencies, property owners, and other stakeholders.

The preliminary design deliverables are documented in Section 2.0 of this Design Baseline Report, which identifies all completed submittals listed as engineering deliverables under Engineering Output in Table 1 of TM 0.1. The Record Set 15% Drawings formed the basis of Volume III of the Final EIR/EIS. The basis of the preliminary design for each engineering discipline, as referenced in the TM, is outlined in individual sections of this report.

Section 1.0

Introduction

1.0 Introduction

1.1 Project Overview

In 1996, the State of California established the California High-Speed Rail Authority (Authority). The Authority is responsible for studying alternatives to construct a rail system that would provide intercity high-speed rail (HSR) service on approximately 800 miles of track throughout California. This rail system would connect the major population centers of Sacramento, the San Francisco Bay Area, the Central Valley, Los Angeles, the Inland Empire, Orange County, and San Diego. The Authority is coordinating the project with the Federal Railroad Administration (FRA). The California HSR Project is envisioned as a state-of-the-art, electrically powered, high-speed, steel-wheel-on-steel-rail technology that would include the latest design in safety, signaling, and automated train-control systems.

Figure 1.1-1 shows the general HSR System layout.

Figure 1.1-1
HSR System Layout

1.2 Purpose

The purpose of this Design Baseline Report (DBR) is to provide a summary of the 15% preliminary engineering design that defines the project alternatives evaluated in the Fresno to Bakersfield (FB) Section Environmental Impact Report/Environmental Impact Statement (EIR/EIS), with emphasis on the Preferred Alternative and its basis of design and selection as the preferred alignment.

1.3 Project Description

1.3.1 Summary of the High-Speed Rail Environmental Review Process

The Authority and FRA have prepared program-wide (Tier 1) environmental documents for the HSR System under the California Environmental Quality Act (CEQA) and the National Environmental Policy Act (NEPA). Specifically, the Authority and FRA prepared the Final Program EIR/EIS for the Proposed California High-Speed Train System (Authority and FRA, 2005) to evaluate the ability of the HSR system to meet the existing and future capacity demands on California's intercity transportation system. The Authority and FRA also prepared the Bay Area to Central Valley HST Program EIR/EIS (Authority and FRA 2008) to identify corridor alignments and the station locations for the connection between the Bay Area and the Central Valley.

The Statewide Program EIR/EIS (Authority and FRA 2005) provided a programmatic analysis of implementing the HSR System across the state, from Sacramento in the north to San Diego in the south and the San Francisco Bay Area in the west. At the conclusion of that first-tier environmental process, the Authority and FRA made the following decisions: selected the high-speed train alternative over no project or expanded freeways and airports (the modal alternative) to meet California's growing intercity transportation needs; selected high-speed steel-wheel-on-steel-rail train technology; selected corridor alignments and station locations for most of the Statewide HSR System to analyze further in second-tier EIR/EIS documents; and adopted programmatic mitigation strategies to carry forward into the second-tier analysis.

The first-tier decisions made by the Authority and FRA established the broad framework for the HSR System that has shaped the scope of issues and project elements ripe for consideration and decision at the second tier. The second-tier of analysis is based on the train technology and vehicle types selected at the conclusion of the first-tier process, and the second-tier evaluates alignment and station alternatives within the general corridor selected in the first-tier environmental process. The second-tier process includes additional preliminary engineering and design and preparation of a project-level EIR/EIS for each HSR section. The FB Section EIR/EIS (Tier 2) evaluates proposed alignments and stations in site-specific detail to provide a complete assessment of the direct, indirect, and cumulative effects of the proposed action; considers public and agency participation in the screening process; and was developed in consultation with resource and regulatory agencies, including EPA and USACE.

The FB Section Draft EIR/EIS was circulated for public review on August 12, 2011. Based on substantive comments received during the public and agency review of the Draft EIR/EIS, the Authority decided to reintroduce alignment alternatives west of Hanford. In response to concerns raised by stakeholders in metropolitan Bakersfield, the Authority and FRA also decided to evaluate another alternative in Bakersfield (Bakersfield Hybrid Alternative) that would minimize impacts on residential and community facilities. The Authority and FRA determined that the introduction of these new alternatives and refinements being considered for existing FB route alternatives required publication of a Revised Draft EIR (DEIR) and Supplemental Draft EIS (DEIS) in compliance with CEQA and NEPA. The Revised DEIR/Supplemental DEIS for the FB Section was released for public review on July 20, 2012. Following an additional public review period, the Final EIR/EIS was issued in April 2014, and the EIR and the project from Fresno

southward to 7th Standard Road in Kern County were approved by the Authority Board on May 7, 2014. The CEQA Notice of Determination was filed on May 8, 2014.

For the HSR project, including the FB Section, the FRA is the lead federal agency for compliance with NEPA and other federal laws. FRA also has primary responsibility for developing and enforcing rail line safety regulations in accordance with the Rail Safety Improvement Act of 2008. The Authority is the project sponsor and joint-lead agency under NEPA.

Two cooperating agencies are included in this NEPA review process. USACE agreed in a letter dated December 30, 2009, to participate as a cooperating agency under NEPA. The Surface Transportation Board (STB) also agreed in a letter dated May 2, 2013, to participate as a cooperating agency under NEPA. Multiple other federal agencies have been involved and have contributed to the NEPA process, including the EPA, U.S. Fish and Wildlife Service (USFWS), National Marine Fisheries Service, National Parks Service, and the Advisory Council on Historic Preservation.

Between the release of the Revised DEIR/Supplemental DEIS and the Final EIR/EIS for the FB Section, the Authority sought authority from STB to construct the Merced to Fresno Section. Because the HSR system would have extensive connectivity with Amtrak, which has long provided interstate passenger service, STB determined that the HSR system would be constructed as part of the interstate rail network. Therefore, STB has jurisdiction over all nine of the proposed HSR sections, including the FB Section.

In light of the STB's jurisdictional decisions, the Authority considered potential applicability of federal preemption. Specifically, the provisions of Section 10501(b) of the ICC Termination Act of 1995 make the STB's jurisdiction "exclusive" for all transportation by rail carriers, including the facilities and structures that are an integral part of that transportation. Section 10501(b) also expressly states that "the remedies provided under this part are exclusive and preempt the remedies provided under Federal and State law." As a general matter, the STB itself and case law interpreting section 10501(b) have concluded that state environmental review or permit requirements, such as CEQA, are preempted.

In 2009, the environmental review process for the Fresno to Bakersfield Section commenced as a joint EIR/EIS to comply with the requirements of both CEQA and NEPA. The Draft EIR/EIS released in 2011 and the Revised Draft EIR/Supplemental Draft EIS released in 2012 included the requisite analysis for compliance with both laws. To avoid confusion, and in light of the timing of the STB's jurisdictional decision, the Authority elected to complete this document as a Final EIR/EIS, with all requisite analysis for compliance with both CEQA and NEPA.

The following California agencies (state and regional) identified to date would have to issue permits or approvals for the FB HSR Section and, therefore, would be CEQA responsible agencies, in the absence of STB jurisdiction: California Department of Fish and Wildlife (CDFW), California Department of Transportation (Caltrans), California Public Utilities Commission, California State Lands Commission, State Water Resources Control Board (SWRCB), Central Valley Flood Protection Board (CVFPB), and San Joaquin Valley Air Pollution Control District. The Final EIR/EIS can be used by those agencies through the provisions of either CEQA Guidelines section 15220 et seq. or CEQA Guidelines section 15096 to approve or permit aspects of the HSR project for which the respective agency is responsible.

The preliminary engineering described in this DBR conforms to all requirements and commitments already documented in decision documents, including the FRA Record of Decision (ROD) and the Authority Notice of Determination (NOD), CEQA Findings of Fact, Mitigation, Monitoring and Enforcement Program, the Final Statewide Program EIR/EIS for the HSR project, and the Bay Area to Central Valley Program EIR/EIS.

In recommending the Preferred Alternative, the Authority balanced environmental factors that differentiated the alternatives and considered input from stakeholders. The environmental issues were identified thus: (1) natural resources impacts, (2) community impacts (including transportation infrastructure), and (3) effects during construction. Only those natural resources that would be significantly affected by the project and would differentiate alternatives were factored into the comparison, such as natural land, vernal pools, conservation areas, park lands and wildlife movement corridors. The following resources were not included in this discussion because either their effects were less than significant or the effects were common among the alternatives considered: hydrology, air quality and global climate change, public utilities and energy, geology, soils and seismicity, hazardous materials and waste, safety and security, electromagnetic fields and interference, station planning, land use and development, and archaeological and paleontological resources.

All alternatives would have substantial effects on suitable habitats for special status species. The potential loss of natural land that is suitable for a variety of special status plant and wildlife species was balanced against the loss of annual grassland habitat. All alternatives would also have substantial impacts on waters of the U.S. (i.e., aquatic communities).

1.3.2 The Fresno to Bakersfield Section

The proposed FB Section of the HSR is approximately 114miles long and traverses a variety of land uses, including agricultural and urban areas. The FB Section would include viaducts and segments where the HSR would be at-grade or on embankment. The preferred route of the FB Section would pass near or through the rural communities of Bowles, Laton, Conejo, Armona, Allensworth, and Crome and the cities of Fresno, Hanford, Corcoran, Wasco, Shafter, and Bakersfield.

The FB Section would extend from north of Stanislaus Street in Fresno to the southern limit of the Bakersfield station tracks near King Street in Bakersfield. The analysis of project impacts, and therefore the preliminary engineering design, was extended an additional 3 miles to Oswell Street because Oswell Street marks the location where the range of alternatives considered for the Fresno to Bakersfield and Bakersfield to Palmdale sections merge, forming a logical point for the identification of alternatives that would cross downtown Bakersfield.

1.3.3 Alignments

The FB Section of the HSR System is a critical link connecting the northern HSR sections of Merced to Fresno and the Bay Area to the southern HSR sections of Bakersfield to Palmdale and Palmdale to Los Angeles. The FB Section would include HSR stations in the cities of Fresno and Bakersfield, with a third station in the vicinity of Hanford. The Fresno and Bakersfield station areas would be this section's project termini.

The FB Section of the HSR is divided into 10 subsections, most of which have multiple alternative alignments. Table 1.3-1 and Figure 1.3-1 illustrate the subsections and their corresponding alignments.

Table 1.3-1
Fresno to Bakersfield Alignment Subsections

Engineering Alignment Designation	Alignment Subsection Name	Location		County	EIR/EIS Alternative Name
		Begin	End		
F1*	Fresno	North of Stanislaus Street	E Lincoln Ave	Fresno	BNSF
M*	Monmouth	E Lincoln Ave	E Kamm Ave	Fresno	BNSF
H*	Hanford	E Kamm Ave	Iona Ave	Fresno and Kings	BNSF (Hanford East)
HW	Hanford West Bypass	E Kamm Ave	Idaho Ave		Hanford West Bypass 1 & 2
HW2	Hanford West Bypass	E Kamm Ave	Iona Ave		Hanford West Bypass 1 & 2 Modified
K1	Kaweah	Idaho Ave	Nevada Ave	Kings	Hanford West Bypass 2 (at-grade) (connects to C1 [Corcoran Elevated] or C2 [Corcoran Bypass])
K2		Idaho Ave	Nevada Ave		Hanford West Bypass 1 (at-grade) (connects to C3 [BNSF through Corcoran])
K3		Iona Ave	Nevada Ave		BNSF (Hanford East) (connects to C3 [BNSF through Corcoran])
K4*		Iona Ave	Nevada Ave		BNSF (Hanford East) (connects to C1 [Corcoran Elevated] or C2 [Corcoran Bypass])
K5		Iona Ave	Nevada Ave		Hanford West Bypass 2 Modified (below-grade) (connects to C1 [Corcoran Elevated] or C2 [Corcoran Bypass])
K6		Iona Ave	Nevada Ave		Hanford West Bypass 1 Modified (below-grade) (connects to C3 [BNSF through Corcoran])
C1	Corcoran	Nevada Ave	Avenue 128	Kings and Tulare	Corcoran Elevated
C2*	Corcoran Bypass	Nevada Ave	Avenue 128		Corcoran Bypass
C3	Corcoran	Nevada Ave	Avenue 128		BNSF (through Corcoran)
P*	Pixley	Avenue 128	Avenue 84	Tulare	BNSF
A1*	Allensworth Bypass	Avenue 84	Elmo Highway	Tulare and Kern	Allensworth Bypass
A2	Through Allensworth	Avenue 84	Elmo Highway		BNSF (through Allensworth)

Engineering Alignment Designation	Alignment Subsection Name	Location		County	EIR/EIS Alternative Name
		Begin	End		
L1*	Poso Creek	Elmo Highway	Whisler Road	Kern	Allensworth Bypass (connects to BNSF [through Wasco-Shafter])
L2		Elmo Highway	Poplar Ave		Allensworth Bypass (connects to Wasco-Shafter Bypass)
L3		Elmo Highway	Whisler Road		BNSF (through Allensworth) (connects to BNSF [through Wasco-Shafter])
L4		Elmo Highway	Poplar Ave		BNSF (through Allensworth) (connects to Wasco-Shafter Bypass)
WS1*	Through Wasco-Shafter	Whisler Road	Hageman Road	Kern	BNSF (through Wasco-Shafter)
WS2	Wasco-Shafter Bypass	Poplar Ave	Hageman Road		Wasco-Shafter Bypass
B1	Bakersfield Urban	Hageman Road	Baker Street	Kern	BNSF (Bakersfield North)
B2	Bakersfield Urban	Hageman Road	Baker Street		Bakersfield South
B3	Bakersfield Urban	Hageman Road	Baker Street		Bakersfield Hybrid
* Signifies an alignment that comprises part of the CHSRA Board-approved alignment.					

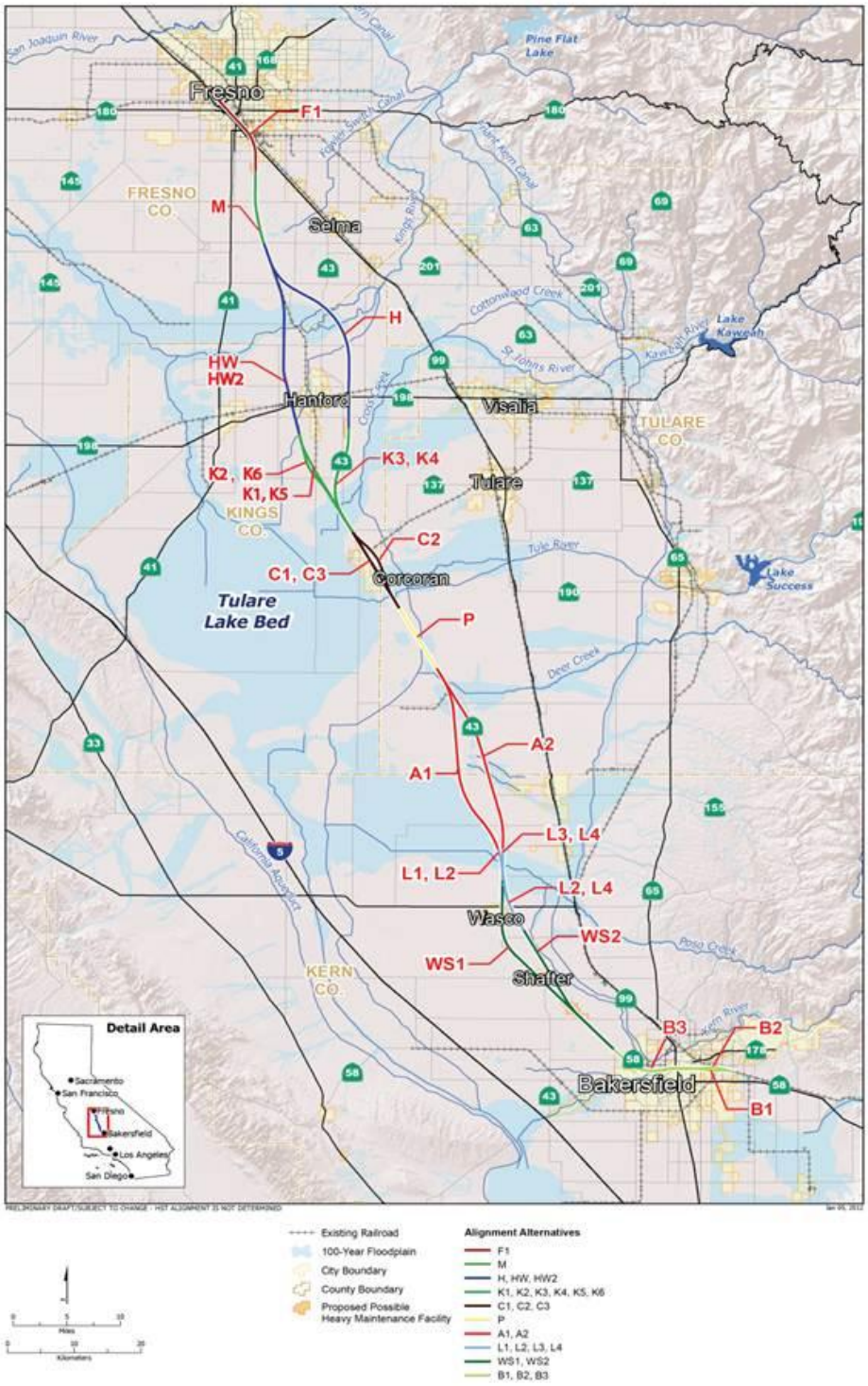

Figure 1.3-1
Overview of Alignment Subsections

The FB Section was divided into a series of subsections for ease of engineering and environmental evaluation.

Fresno (F1) and Monmouth (M)

The proposed location of Fresno Station at Mariposa Street had been determined as the southern terminus of the Merced to Fresno Section environmental analyses, for which a ROD was signed in 2012. The FB Environmental Section overlaps the Merced to Fresno Section in the station area from Mariposa Street to approximately 725 feet north of Stanislaus Street. Only one HSR alignment alternative, F1, was evaluated for the subsection that would extend southeastward from Fresno alongside the Union Pacific Railroad (UPRR) to its crossing of State Route (SR) 99, and then alongside the BNSF Railway (BNSF) southward from Fresno to Jefferson Avenue. F1 would then merge with the Monmouth subsection (M), which is at-grade, and continue southward alongside the BNSF as far as East Kamm Avenue.

Hanford (H, HW, and HW2) and Kaweah (K1, K2, K3, K4, K5, and K6)

At East Kamm Avenue, the HSR divides into three alternative subsections: (a) East of Hanford, referred to as the Hanford alignment (H), which features an elevated Kings/Tulare Regional (KTR) East Station option; (b) West of Hanford, referred to as the Hanford West Bypass alignment (HW), which would feature an at-grade KTR West Station option; and (c) Hanford West Bypass modified alignment (HW2), which would feature a below-grade KTR West Station option.

The H alignment would cross over the BNSF near East Conejo Avenue and run at-grade to the east of the City of Hanford before ascending onto a viaduct to cross over the Kings River floodplain. After leaving the floodplain, the H alignment would return to grade, and then ascend again at East Fargo Avenue to cross over the San Joaquin Valley Railroad and the SR 198. This viaduct would serve the proposed KTR East Station, located north of SR 198. The H alignment would connect with the Corcoran subsection alternatives (C1, C2, and C3) via the Kaweah connector alternatives (K3 and K4).

The HW alignment would continue alongside the BNSF to South Clovis Avenue, where the HSR would deviate from the BNSF passing to the west of Layton and ascend to cross over the Grant Canal and Kings River complex northern floodplain. After leaving the southern floodplain, the alignment would return to an at-grade profile to Grangeville Boulevard where there are two options for the HSR station at Hanford: (a) below grade where the station platforms are depressed below ground level on the HW2 alignment, and (b) at-grade station option on the HW alignment. The HW2 alignment is offset from the HW alignment by a maximum of 330 feet to the west. The below-grade option returns to grade at East Houston Avenue. Both alignments then connect with the Corcoran subsection alternatives (C1, C2, and C3) via the Kaweah connector alternatives (K1, K2, K5, and K6).

Corcoran (C1, C2, and C3)

The HSR would rejoin the BNSF via the Kaweah connector alternatives at East Nevada Avenue, where the HSR would divide into three alternative subsections: C1, which would pass through the City of Corcoran on viaduct on the eastern side of BNSF; C2, which would bypass Corcoran to the east; and C3, which would also pass through the City of Corcoran on viaduct on the western side of the BNSF. These subsections extend as far as Avenue 128.

Pixley (P)

Only one HSR alignment alternative (P) was evaluated for this subsection that would run alongside BNSF and SR 43 between Avenue 128 and Avenue 84, connecting the Corcoran subsections to the Allensworth subsections.

Allensworth (A1 and A2)

At Avenue 84, the HSR would divide into two alternative subsections: (a) Allensworth Bypass (A1), which would bypass the town of Allensworth to the west; and (b) the A2 alignment, which would pass through Allensworth alongside the BNSF and SR 43 southward to Elmo Highway.

Poso Creek (L1, L2, L3, and L4)

Poso Creek alternatives are proposed connectors between the Allensworth and Wasco-Shafter alternatives: (a) L1 links A1 to the BNSF Alternative through the towns of Wasco and Shafter (WS1) on the western side of the BNSF; (b) L2 links A1 to the Wasco-Shafter Bypass (WS2) requiring the HSR to cross over the BNSF before returning to grade east of the City of Wasco; (c) L3 links A2 to WS1 north of the City of Wasco; and (d) L4 links A2 to WS2, also crossing over the BNSF before returning to grade east of the City of Wasco.

Wasco-Shafter (WS1 and WS2)

There are two proposed alternative alignments in Wasco and Shafter: (a) the BNSF through Wasco-Shafter (WS1) subsection starts at Whisler Road, passes through Wasco mostly on viaduct on the western side of the BNSF, crosses over the BNSF near Jackson Avenue, returns to grade to the City of Shafter, where the HSR ascends onto viaduct through Shafter before crossing over the BNSF on viaduct and returning to grade on the western side of BNSF at Hageman Road; and (b) the Wasco-Shafter Bypass (WS2) bypasses both Wasco and Shafter at grade to the east before ascending to cross over the BNSF tracks near 7th Standard Road, then returning to grade on the eastern side of the BNSF at Hageman Road.

Bakersfield (B1, B2 and B3)

Three subsection alternative alignments would go through the City of Bakersfield. All HSR subsections would run alongside the BNSF between Hageman Road and Rosedale Highway, where these HSR alignments would ascend onto viaduct in the western part of Bakersfield. After crossing over Brimhall Road, the HSR would divide into two alternative alignment subsections: B1; and B2. A third Bakersfield subsection alternative (B3) is a hybrid alignment combining B2 and B1.

The B1 alignment would remain on viaduct mostly on the southern side of the BNSF main line through Bakersfield. The HSR approach to the elevated Bakersfield B1 HSR station option would partially straddle the BNSF tracks adjacent to the Amtrak Station. B1 would continue alongside Truxtun Avenue before curving westward to run alongside Edison Highway and the combined BNSF and UPRR rights-of-way to Oswell Street.

B2 alignment would cross the Kern River, Westside Parkway, Truxtun Avenue, and the BNSF before passing through the city's Corporation Yard and paralleling the northern side of the BNSF main line. B2 would continue eastward between 16th Street and the BNSF until crossing back over the BNSF on a skew crossing at L Street. B2 would deviate away from the BNSF at the elevated Bakersfield B2 HSR station option, which extends to Kern Street. B2 would continue and join East California Avenue with the viaduct supports occupying the central reserve of East California Avenue. The HSR then would curve to the west to merge with the B1 alternative

alignment alongside Edison Highway and the combined BNSF and UPRR rights-of-way at Oswell Street.

B3 has the same alignment and profile as B2 between Hageman Road the city's Corporation Yard, except that B3 would cross the BNSF near G Street. After crossing the BNSF on a relatively tight reverse curve (necessitating a lower design speed), B3 then would follow the southern side of the BNSF for the Bakersfield B3 HSR station option, and continue eastward to Oswell Street.

1.3.4 The Fresno to Bakersfield Section Preferred Alternative

The Authority staff recommendation for the FB Section Preferred Alternative, announced at the November 4, 2013, Authority Board meeting, comprises parts of the BNSF Alternative (F1, M, H, K4, P, L1, and WS1 alignments), along with the Corcoran Bypass Alternative (C2), the Allensworth Bypass Alternative (A1 alignment), and the Bakersfield Hybrid Alternative (B3 alignment). Table 1.3-1 lists the preferred alternative alignments. The preferred alternative also includes the previously approved HSR station in downtown Fresno at Mariposa Street, the downtown Bakersfield Station on the B3 alignment, and KTR Station, located between Hanford and Visalia on SR 198. The Fresno to Bakersfield Section Final EIR and the project from Fresno south to 7th Standard Road was approved by the Authority Board on May 7, 2014. The CEQA Notice of Determination was filed with the state Clearinghouse on May 8, 2014. The NEPA Record of Decision (ROD) for the Final EIS is pending with the FRA at the time of this report.

The preferred alternative was selected based on a balanced consideration of the environmental information presented in the Draft EIR/EIS and Revised Draft EIR/Supplemental Draft EIS in the context of CEQA, NEPA, and federal Clean Water Act Section 404(b) (1) requirements, as well as local and regional land use plans, community preferences, and cost. The identification of the preferred alternative also integrates FRA's evaluation under Section 4(f) of the Department of Transportation Act (49 U.S.C. 303), which provides special protection to publicly owned public parks; recreational areas of national, state, or local significance; wildlife or waterfowl refuges; and lands of a historic site of national, state, or local significance.

The Fresno Station–Mariposa Alternative was approved by the Authority Board and by the FRA in its Record of Decision (ROD) after the Merced to Fresno Final EIR/EIS was issued in 2012. Consistent with those decisions and the analysis in the Fresno to Bakersfield Final EIR/EIS, the Fresno Station–Mariposa Alternative is identified as the preferred downtown Fresno Station location.

The BNSF Alternative through Hanford (Hanford East Alternative) (H) and the Corcoran Bypass (C2) were selected for the preferred alternative because they are more compatible with the long-range development planning for the city of Hanford and the region as a whole, which will result in more options for regional development. In addition, these alternatives would result in slightly fewer potential impacts on the natural environment, and the community impacts are similar in both intensity and severity in Hanford and Corcoran when compared to the other alignment alternatives. FRA has also determined that the BNSF Alternative east of Hanford would result in the least overall harm to properties protected under Section 4(f). The Kings/Tulare Regional Station-East is part of the preferred alternative because it is located on the preferred alignment in the Hanford area.

The Allensworth Bypass (A1) is the preferred alternative because it results in fewer impacts on both the natural environment (e.g., wetlands and special-status species habitat) and communities than the BNSF Alternative does in the Allensworth area (A2). It also avoids the use of two properties protected under Section 4(f).

Given the similarities of the impacts on natural resources between the two alternatives in the Wasco/Shafter area and the possibility to address community impacts of the BNSF Alternative through mitigation, the Authority and FRA identified the BNSF Alternative through Wasco and Shafter (WS1) as preferred. This selection also satisfies a project objective that the HST System follow existing transportation or utility corridors to the extent feasible. FRA and the Authority considered the strong regional interests, consistency with the long-term development plans in Shafter, and the cost uncertainties associated with constructing the project in existing and rapidly expanding oil fields in the context of this project objective when identifying the BNSF Alternative through Wasco and Shafter as the preferred alternative.

The Bakersfield Hybrid Alternative (B3) and its corresponding station site comprise the preferred alternative through the City of Bakersfield because the alternative would impact the fewest acres of waters of the U.S. when compared with the BNSF Alternative (B1) and because it would result in fewer community impacts including fewer overall displacements and fewer impacts on religious facilities when compared with both the BNSF Alternative (B1) and Bakersfield South Alternative (B2). The Authority and FRA developed the Bakersfield Hybrid Alternative in response to community concerns received after publication of the Draft EIR/EIS and after proactive engagement with the communities to solicit input and to combine the best of the BNSF Alternative and the Bakersfield South Alternative.

Section 2.0

Documentation of 15% Design Engineering Output

2.0 Documentation of 15% Design Engineering Output

Table 2.0-1 lists deliverables documenting the 15% Design Engineering Output.

Table 2.0-1
15% Design Engineering Documentation

Discipline	Engineering Output	Document Title	Document Type	Description	Hyperlink To Document on Client Servers
Alignment (Plan and Profile)	Alignment design (plan, elevation, cross-section) including: • Horizontal Alignment showing key existing features (e.g., roadways and driveways, utilities, water bodies, existing structures ,etc.) • Vertical Alignment showing key existing features (ground and existing structures, water bodies, over and under crossings) • Hydraulic crossings • Typical cross-sections • Station location alternatives (KTR and Bakersfield only) • Limits of at-grade, elevated, and underground structures • Retaining wall locations • Right-of-way limits for each alternative • Roadways and railroad in proximity to the proposed alignments (typical sections only) List of Alignment-related Design Variances	Alignment DGN and data files Record Set 15% Design Submission Alignment Plans and Profiles and Cross-Sections Part 1 of 2 and Part 2 of 2 Design Variance List	Drawings Drawings Spreadsheet	Record Set 15% Design Submittal	Alignment Plans, Part 1/ 2 https://chsra.pbid.com/rc/FB/dr/FB%2015pct%20RS%20Design%20Submittal%20May2014/FB%2015pct%20RS%20Design%20Submittal%20May2014%20-%20Alignment%20Plans%20-%20Part%201%20of%202.pdf Alignment Plans, Part 2/2 https://chsra.pbid.com/rc/FB/dr/FB%2015pct%20RS%20Design%20Submittal%20May2014/FB%2015pct%20RS%20Design%20Submittal%20May2014%20-%20Alignment%20Plans%20-%20Part%202%20of%202.pdf Design Variance List https://ww3.projectsolve2.com/eRoomReq/Files/SFOF/CHSTP-FresnotoBakersfieldSection/0_1036ef/FB%2015pct%20RS%20Design%20Submittal%20Dec2013%20-%20Design%20Variance%20List.pdf
Temporary Construction Facilities	Constructability assessment memorandum covering: • Construction staging concepts as needed to determine limits and to characterize temporary impacts during construction • Temporary construction/staging sites Develop assumptions and quantities for level of construction activities to support air quality analysis Bakersfield Constructability Memorandum	Record Set 15% Design Submission Constructability Assessment Memo Record Set 15% Design Submission Bakersfield Constructability Memorandum	Report Memorandum	Record Set 15% Design Submittal Record Set 15% Design Submittal	Constructability Assessment Memo https://chsra.pbid.com/rc/FB/dr/FB%2015pct%20RS%20Design%20Submittal%20Dec2013%20-%20Constructability%20Assessment%20Memorandum.pdf Bakersfield Constructability Memo https://chsra.pbid.com/rc/FB/dr/FB%2015pct%20RS%20Bakersfield%20Constructability%20Memo%20Apr2014%20%20Complete/FB%2015pct%20RS%20Bakersfield%20Constructability%20Memo%20Apr2014%20-%20Complete.pdf .
Stations	Station Site alternatives covering: • Station footprints • Vehicular and bicycle parking and site configuration • Station Platforms: number, configuration, location • Vertical and horizontal circulation elements • Off-site parking locations and station access routing • Intermodal and public transit connections	Record Set 15% Design Submission Station Plans, Elevations and Typical Sections	Drawings	Record Set 15% Design Submittal	Station Plans https://chsra.pbid.com/rc/FB/dr/FB%2015pct%20RS%20Design%20Submittal%20May2014/FB%2015pct%20RS%20Design%20Submittal%20May2014%20-%20Station%20Plans.pdf

Discipline	Engineering Output	Document Title	Document Type	Description	Hyperlink To Document on Client Servers
HSR Bridges and Elevated Structures	Structure design (plan, elevation, cross-section) to APS level including: • Bridge length, width, depth, max. height • Column/footing locations • Foundation types • Number of spans • Transition structures • Changes to affected adjacent facilities (pedestrian, roadway, highway, railroad) Advanced Planning Study Report including • Structure importance and operational baseline equivalent to Caltrans lifeline • Key design and site constraints • Seismic, soils, hydrologic, hydraulic and geomorphic design considerations List of HSR Structures-related Design Variances	Record Set 15% Design Submission HSR Structure Plans and Elevations and Typical Sections, Part 1 of 2 and Part of 2 Record Set 15% Design Submission Advance Planning Study Report Design Variance List	Drawings Drawings Report Spreadsheet	Record Set 15% Design Submittal	HSR Structure Plans, Part 1/2 https://chsra.pbid.com/rc/FB/dr/FB%2015pct%20RS%20Design%20Submittal%20May2014/FB%2015pct%20RS%20Design%20Submittal%20May2014%20-%20HST%20Structure%20Plans%20-%20Part%201%20of%202.pdf HSR Structure Plans, Part 2/2 https://chsra.pbid.com/rc/FB/dr/FB%2015pct%20RS%20Design%20Submittal%20May2014/FB%2015pct%20RS%20Design%20Submittal%20May2014%20-%20HST%20Structure%20Plans%20-%20Part%202%20of%202.pdf Advanced Planning Study (APS) https://chsra.pbid.com/rc/FB/dr/FB%2015pct%20RS%20Design%20Submittal%20Dec2013%20-%20Advance%20Planning%20Study%20-%20Complete.pdf Design Variance List https://chsra.pbid.com/rc/FB/dr/FB%2015pct%20RS%20Design%20Submission%20-%20Design%20Variance%20List.xlsx
Tunnels	N/A				
Buildings	N/A				
Grading/ Earthwork	Alignment Plans and Profiles capture: • Cut-and-fill slope catch points included on alignment plans • Retaining wall locations, lengths and heights • Construction easement requirements • Operations, emergency and maintenance access identification, locations, and right-of-way	Refer to Alignment Plans and Profiles and Cross-Sections			
Hydrology/ Hydraulics/ Drainage	Hydrology and Hydraulics Report Floodplain Impacts Assessment Report Storm Water Management Report Additional information as needed to support Section 408, Section 404, Section 401/402 determinations (e.g., hydraulic basis of design in service of regulatory permitting)	Record Set 15% Design Submission Hydrology Hydraulics and Drainage Report Record Set 15% Design Submission Floodplain Impact Report Record Set 15% Design Submission Stormwater Quality Management Report	Report Report Report	Record Set 15% Design Submittal	HH&D Report https://chsra.pbid.com/rc/FB/dr/FB%2015pct%20RS%20Design%20Submittal%20Dec2013%20-%20Hydrology%20Hydraulics%20and%20Drainage%20Report%20-%20Complete.pdf Floodplain Report https://chsra.pbid.com/rc/FB/dr/FB%2015pct%20RS%20Design%20Submittal%20Dec2013%20-%20Floodplain%20Impact%20Report%20-%20Complete.pdf Stormwater Report https://chsra.pbid.com/rc/FB/dr/FB%2015pct%20RS%20Design%20Submittal%20Dec2013%20-%20Stormwater%20Quality%20Management%20Report%20-%20Complete.pdf
Utilities	High-Risk Utilities Impact Report including: • Existing utilities within project limits per TM 2.7.4, *Utility Requirements for 15% Design Level* • Define existing footprints for high-risk utilities	Record Set 15% Design Submission Utility Impact Report	Report	Record Set 15% Design Submittal	Utility Impacts Report https://chsra.pbid.com/rc/FB/dr/FB%2015pct%20RS%20Design%20Submittal%20Dec2013%20-%20Utility%20Impact%20Report%20-%20Complete.pdf

Discipline	Engineering Output	Document Title	Document Type	Description	Hyperlink To Document on Client Servers
Geotechnical	Updated Geotechnical Database Geotechnical Investigation Work Plan Additional information as needed to support Section 408 determinations (e.g., geotechnical basis of design in service of regulatory permitting)	Geotechnical Data Geotechnical Data Report – Historical Borehole Data Addendum to Geotechnical Data Report – Historical Borehole Data Record Set 15% Design Submission Geological and Seismic hazards Report Record Set 15% Design Submission Geotech Investigation Work Plan	Data Files Report Report Report Report Report	Data Data Data Record Set 15% Design Submittal	Geotechnical Data Report – Historical Borehole Data https://chsra.pbid.com/rc/FB/dr/FP%20Geotech%20Historical%20Data%20Summary%202010-05-10r1.pdf Geotechnical Historical Borehole Data https://chsra.pbid.com/rc/FB/dr/FP%20Geotech%20Historical%20Boreholes%20Data%201%20of%2016.zip https://chsra.pbid.com/rc/FB/dr/FP%20Geotech%20Historical%20Boreholes%20Data%202%20of%2016.zip https://chsra.pbid.com/rc/FB/dr/FP%20Geotech%20Historical%20Boreholes%20Data%203%20of%2016.zip https://chsra.pbid.com/rc/FB/dr/FP%20Geotech%20Historical%20Boreholes%20Data%204%20of%2016.zip https://chsra.pbid.com/rc/FB/dr/FP%20Geotech%20Historical%20Boreholes%20Data%205%20of%2016.zip https://chsra.pbid.com/rc/FB/dr/FP%20Geotech%20Historical%20Boreholes%20Data%206%20of%2016.zip https://chsra.pbid.com/rc/FB/dr/FP%20Geotech%20Historical%20Boreholes%20Data%207%20of%2016.zip https://chsra.pbid.com/rc/FB/dr/FP%20Geotech%20Historical%20Boreholes%20Data%208%20of%2016.zip https://chsra.pbid.com/rc/FB/dr/FP%20Geotech%20Historical%20Boreholes%20Data%209%20of%2016.zip https://chsra.pbid.com/rc/FB/dr/FP%20Geotech%20Historical%20Boreholes%20Data%2010%20of%2016.zip https://chsra.pbid.com/rc/FB/dr/FP%20Geotech%20Historical%20Boreholes%20Data%2011%20of%2016.zip https://chsra.pbid.com/rc/FB/dr/FP%20Geotech%20Historical%20Boreholes%20Data%2012%20of%2016.zip https://chsra.pbid.com/rc/FB/dr/FP%20Geotech%20Historical%20Boreholes%20Data%2013%20of%2016.zip https://chsra.pbid.com/rc/FB/dr/FP%20Geotech%20Historical%20Boreholes%20Data%2014%20of%2016.zip https://chsra.pbid.com/rc/FB/dr/FP%20Geotech%20Historical%20Boreholes%20Data%2015%20of%2016.zip https://chsra.pbid.com/rc/FB/dr/FP%20Geotech%20Historical%20Boreholes%20Data%2016%20of%2016.zip https://chsra.pbid.com/rc/FB/dr/FP%20Geotechnical%20gINT%20database%202010-05-26.gpj Addendum to Geotechnical Data Report – Historical Borehole Data https://chsra.pbid.com/rc/FB/dr/FB%2015pct%20Draft%20RBNSF%20HWB-Historical%20Borehole%20Database-Report.pdf Geologic and Seismic Hazards Report https://ww3.projectsolve2.com/eRoomReq/Files/SFOF/CHSTP-FresnotoBakersfieldSection/0_103633/FB%2015pct%20RS%20Design%20Submittal%20Dec2013%20-%20Geologic%20and%20Seismic%20Hazard%20Report%20-%20Complete.pdf GI Work Plan for DP 2/3 and DP 4 https://chsra.pbid.com/rc/FB/dr/FB%2015pct%20RS%20Design%20Submittal%20Dec2013%20-%20Geotech%20Investigation%20Work%20Plan%20-%20Complete.pdf
Right-of-Way	Preliminary Right-of-Way Requirements Report	Record Set 15% Design Submission Preliminary right-of-way Requirements Report	Report	Record Set 15% Design Submittal	Preliminary Right-of-Way Requirements Report https://chsra.pbid.com/rc/FB/dr/FB%2015pct%20RS%20Design%20Submittal%20Jan2014%20-%20Preliminary%20ROW%20Requirements%20Report%20-%20Complete.pdf

Discipline	Engineering Output	Document Title	Document Type	Description	Hyperlink To Document on Client Servers
Roadway Plans and Structures	Roadway design (plan, elevation, cross-section) including: • Horizontal Alignment. Super elevation designed only for State Highways, not local roadways. • Vertical Alignment showing key existing features (ground, water bodies, over and under crossings. • Access (pedestrian and vehicular). • Typical cross-sections. • Right-of-Way limits including temporary easements and maintenance access for HSR. • Driveway relocations. • Proposed speeds. Alignment Data Files (including horizontal and vertical InRoads/InRail data files) in electronic format. Roadway Structure design (plan, elevation, cross-section) to APS level including: • Grade-Separation Structures for road over crossings. Advanced Planning Study Report including: • Key design and site constraints List of Roadways-related Design Variances	DGN and data files Record Set 15% Design Submission Roadway and Grade Separation Plans and Profiles and Cross-Sections Part 1 of 2 and Part 2 of 2 Record Set 15% Design Submission Roadway Structure Plans Overhead Planning Studies Record Set 15% Design Submission Advance Planning Study Report Design Variance List	Electronic files Drawings Drawings Report Spreadsheet	Record Set 15% Design Submittal	Roadway Plans, Part 1/2 https://chsra.pbid.com/rc/FB/dr/FB%2015pct%20RS%20Design%20Submittal%20May2014/FB%2015pct%20RS%20Design%20Submittal%20May2014%20-%20Roadway%20Plans%20-%20Part%201%20of%202.pdf Roadway Plans, Part 2/2 https://chsra.pbid.com/rc/FB/dr/FB%2015pct%20RS%20Design%20Submittal%20May2014/FB%2015pct%20RS%20Design%20Submittal%20May2014%20-%20Roadway%20Plans%20-%20Part%202%20of%202.pdf Roadway Structure Plans https://chsra.pbid.com/rc/FB/dr/FB%2015pct%20RS%20Design%20Submittal%20May2014/FB%2015pct%20RS%20Design%20Submittal%20May2014%20-%20Roadway%20Structure%20Plans.pdf Advance Planning Study (APS) https://chsra.pbid.com/rc/FB/dr/FB%2015pct%20RS%20Design%20Submittal%20Dec2013%20-%20Advance%20Planning%20Study%20-%20Complete.pdf Design Variance List https://chsra.pbid.com/rc/FB/dr/FB%2015pct%20RS%20Design%20Submission%20-%20Design%20Variance%20List.xlsx
Systems – Traction Power – Utility/ Electric Power Connections – Communi-cations – Trackside Services/ Train Control System	Alignment Plans capture: • Traction Power site locations, alternatives, access and footprint requirements • Utility/Electric Power TPSS switching station access and footprint requirements • Communications site locations, alternatives, access and footprint requirements • Train control interlocking site locations, access and footprint requirements – List of Systems-related Design Variances	Refer to Alignment Plans and Profiles and Cross-Sections Design Variance List	Spreadsheet		Design Variance List https://chsra.pbid.com/rc/FB/dr/FB%2015pct%20RS%20Design%20Submission%20-%20Design%20Variance%20List.xlsx
Infrastructure Quantities	– 15% Design level quantities – Construction costs – Cost adjustments to reflect regional conditions	Record Set 15% Design Submission Basis of Quantities Report	Report and Spreadsheets	Record Set 15% Design Submittal	Basis of Quantities Report (BOQ) and Spreadsheet https://chsra.pbid.com/rc/FB/dr/FB%2015pct%20RS%20Design%20Submittal%20Dec2013%20-%20Basis%20of%20Quantities%20Report%20-%20Final.pdf https://chsra.pbid.com/rc/FB/dr/FB%2015pct%20RS%20Design%20Submittal%20Dec2013%20-%20Basis%20of%20Quantities%20Report%20-%20Master%20Spreadsheet.xlsx

Section 3.0

Survey and Mapping

3.0 Survey and Mapping

3.1 General Description

Aerial topographic mapping for preliminary design was obtained per Technical Memorandum (TM) 1.1.4, dated March 2, 2010. The photographic mapping was provided at 1"=100' scale using airborne global positioning system methods. A digital terrain model (DTM) was provided as an InRoads.dtm file with 2-foot contour intervals. Color ortho imagery was provided with a 0.35-foot pixel size. The topographic mapping, DTM, and ortho imagery were provided on a portable hard drive due to the very large file size.

3.2 Methodology

Control survey monuments were provided at 10-mile intervals by the Program Management Team. The horizontal control network is North American Datum 83 with epoch 2007, commonly known as NAD 83 (2007). The vertical datum is North American Vertical Datum 88 using GEOID09. A single strip was flown along the centerline of the alignment resulting in a strip map roughly 1,800 feet wide on each side of the alignment. North of Bakersfield, all alignments, except for the through Allensworth alternative were mapped between 2010 and 2012. In Bakersfield, because all HSR alignments were located on aerial structures and there is only one highway overcrossing, a single strip was flown to best approximate the average of the two alignments under consideration in 2011.

3.3 Limiting Conditions

Aerial mapping was flown in straight flight lines. This flight pattern resulted in some flight strips with up to 100 feet of variance between the east and west side of centerline. Minor high-speed track alignment design shifts, of up to 200 feet, occurred after the mapping was completed. Due to the aerial mapping widths of roughly 3,780 feet, some highway overcrossing roadway conforms extend outside of the limits of the topographic mapping. In general, due to the very flat terrain in the Central Valley and the high cost to fly these isolated locations, these areas were not mapped. In some cases, the aerial topographic vendor, TetraTech, was able to extend the DTM by up to 200 feet to provide additional design information. This supplemental data was also provided on a portable hard drive in 2013.

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Section 4.0

Right-of-Way

4.0 Right-of-Way

4.1 Methodology

The footprint of the HSR was used to assess the right-of-way impacts and consists of the HSR track corridor and associated roadway relocations and crossings. There are both permanent and temporary right-of-way impacts associated with the HSR. Temporary and permanent easements occur in areas outside of the permanent right-of-way for the project that are required for construction. These areas may include utility relocations, contractor staging areas, or work to conform to existing private facilities.

Permanent impacts occur within the project's permanent right-of-way, including aerial, at-grade, and depressed tracks; roadways; stations; traction power substations (TPSSs); radio communication sites; maintenance of infrastructure facilities; and a heavy maintenance facility (HMF). The footprint for the track is defined as up to 100 feet wide in aerial sections. For the at-grade sections, the footprint varies between 100 feet and 150 feet wide, depending on the height of the fill required. The footprints for the roadways are defined by the outer limits of the embankments or cuts of the grade-separations plus areas needed for drainage detention basins. The areas denoted as HSR stations are included in the footprint. The HMF was assessed as a single location for costing purposes.

Existing right-of-way information was gathered from the counties within this section from the digital assessor's parcel map data, specifically the assessor's parcel number and the parcel size. The parcel information and HSR footprint were displayed in a geographic information system (GIS) format, and the overlapping area was recorded as the necessary right-of-way for each alignment of the HSR section.

The majority of parcels would require a partial acquisition of their total area, resulting in a remainder not needed for the project. In some cases, a full acquisition of the parcel (with or without excess lands) was determined necessary. This will be the case if the Regional Consultant (RC) observed that either (a) the remainder is not a viable economic unit that retains its highest and best use or (b) the impact to remaining land and improvements is too great to continue to function. In other cases, damages to an area of a parcel were determined necessary. An area was classified as "damaged" if the RC observed that there will be no legal access, in addition to the criteria used for full acquisitions.

4.2 Cost Methodology

The formal valuation/appraisal and acquisition of property under eminent domain is a complex process to ensure all of the elements of the state and federal Uniform Relocation Assistance and Real Property Acquisition Policies Act (Uniform Act) as amended are considered. The Uniform Act requires that an appraisal be prepared and that no less than the appraised fair market value be offered to the owner. An appraisal requires a personal inspection of the property, as well as a review and analysis of the title elements to the property. The formal appraisal process will begin once the draft appraisal maps are completed in spring 2014.

To prepare the preliminary estimate of the costs of right-of-way impacts, each parcel was placed into a classification based on land use and whether any structures were impacted. Unit values for land and site improvements were assigned to each classification. Publicly available satellite imagery was used to ascertain the current land use and relative quality and condition of improvements on each impacted parcel. Field observations were made in the urban portions of the project limits for the purpose of validating some of the determinations made via the publicly available satellite imagery, particularly improvement quality, condition, and value. These field observations serve as the basis of values for improved properties.

Relocation, severance, and escrow costs were also included in the analysis.

Values for the various land uses and improvements were estimated from local real estate listings obtained from the LoopNet website. Table 4.2-1 includes a summary of land and improvement base unit values, denoted by parcel land use classifications. In some instances, land unit values were further arrayed within a classification based on a range in size of the land. Land unit values were applied directly to the areas required for acquisition as estimated for the various alignments, on a parcel basis. Site improvements and possible severance damages were also included as a percentage of the acquisition costs.

An existing rail corridor is generally considered to have a land value that reflects the assemblage of the corridor area with the adjacent parcel. The existing railroad corridors through large and small urban areas related to the HSR generally are zoned for industrial uses. The existing BNSF railway corridor in the rural areas passes through land generally zoned for agricultural uses. In all areas, the non-operating railroad right-of-way within the HSR footprint has been assigned a land use classification equivalent to the adjacent parcels. It has been assumed that easements would be granted for the aerial crossings of the existing rail. The potential cost for those easements has not been included in this analysis.

The unit value for all land classifications is derived by dividing listing prices by the assumed size of the larger parcel. The price per acre for farmland includes land, outbuildings, irrigation systems, turn rows, and plantings. Additionally, the soil classification and quality of plantings provide for crop yields that result in the income stream. The utility of the remainder can be based on the appraiser's consideration of size, shape, irrigation, and ownership. In some cases, the utility can be partially or wholly restored, provided the restoration costs are considered feasible as established by case law. An owner is entitled to declare his/her remainder an "uneconomic remnant" and request the acquiring agency to acquire the remainder.

The RC derived the base unit value for industrial and commercial improvements by dividing the price of local real estate listings by the size of the improvements for the respective improved parcel classifications, except for residential improvements. The size of the improvements located in or straddling the right-of-way was estimated using publicly available aerial imagery. The appropriate improvement base unit value was applied to the estimated size, and the resultant value was adjusted upward or downward for observed size, age, condition, and quality of construction of the improvement. The lump sum costs for single-family and multifamily residential improvements were derived by direct comparison to real estate listings of similarly improved properties and adjusted for observed age, quality of construction, and condition. The total cost for individual parcels was estimated by totaling the land value, improvement value, severance damages, demolition, and relocation assistance.

Table 4.2-1
Parcel Land Use Classifications Base Value Information

Classification	Description	Size	Unit Value		
			($/ac)	Site Improvements	Severance
Land Only					
A1, A1.1	Ag w/ & w/o Imp	<10 Acre	$35,000	20%	40%
		>10 Acre	$25,000	20%	40%
	Ag Farm Ind	All	$100,000	10%	40%
A1 & A1.1 Blend	HMF and Mainline Through HMF Site	All	$54,950	20%	20%
C1, C1.1, O1, O1.1, M	Com, Office, & Motel w/ & w/o Imp	<0.75 Acre	$900,000	20%	10%
		0.75–2.00 Acre	$525,000	20%	10%
		>2.00 Acre	$435,000	20%	10%
I1,I1.1,I2,I2.1	Light & Heavy Ind w/ & w/o Imp	<5 Acre	$305,000	15%	10%
		>5 Acre	$250,000	15%	10%
R1, R1.1	SF Residential w/ & w/o Imp	All	$200,000	25%	20%
R2, R2.1	MF Residential w/ & w/o Imp	All	$250,000	25%	20%
MH	Mobile Home Park	All	$1,000,000	20%	10%
OS	Open Space/Park	All	$350,000	—	20%
P	Pasture/Fallow	All	$20,000	—	10%
Improvements Only					
I1.1 & I2.1	Ind Buildings	All	$50/ft^2 plus or minus*		
C1.1 & O1.1	Com Buildings	All	$75/ft^2 plus or minus*		
A1.1 & R1.1, R2.1, MH	Res Improvements	All	Lump Sum Based on Comparable Listings		
*Cost was adjusted for quality, condition, and age of the improvement.					
Ag = agricultural		MF = multifamily		HMF = heavy maintenance facility	
Imp = improvements		Com = commercial		Res = residential	
Ind = industrial		ft^2 = square foot		SF = single family	

4.3 Right-of-Way Impact Summary

The total area in acres of estimated right-of-way impacts was tabulated, including full and partial takes, by land use classification, HSR alignment, and proposed use within each of the alignments. The Draft 15% Preliminary Right-of-Way Requirements Report (URS/HMM/Arup 2014) estimated impacted permanent right-of-way area and cost in 2013 dollars, including temporary right-of-way impacts. That report also contains the number of parcels by land use for each alignment. Table 4.3.1 provides a summary of this information. Back-up files, in GIS format, are available to support the following information.

Table 4.3-1
Right-of-Way Impact Summary

Alignment	Cost (in Millions)		Acres		Number of Parcels
	Right-of-way	Easements	Right-of-way	Easements	
F	$192.4	$14.6	220	95	211
M	$34.1	$0.4	436	5	174
H	$96.0	$11.7	979	475	193
K4	$23.4	$2.0	360	65	55
C2	$38.7	$6.9	440	360	87
P	$19.8	$0.2	289	7	31
A1	$77.2	$5.5	2,069	157	146
L1	$6.7	$0.6	106	27	11
WS1	$113.9	$18.0	826	582	263
B3	$162.9	$30.3	303	220	554
Totals	$765.1	$90.2	6028	1993	1725
* Based on the June 2013 Draft 15% Preliminary Right-of-Way Requirements Report.					

Section 5.0

Track Alignment

5.0 Track Alignment

The following sections describe the track alignment for the FB Section and the constraints and design rationale that formed the preferred alignment.

5.1 Overview

From Fresno Station heading south, the alignment would be adjacent to and on the west side of the UPRR corridor. South of Fresno, the alignment would turn south to parallel the BNSF corridor. The alignment would remain adjacent to the BNSF corridor until Conejo Avenue where the HSR alignment would turn east, diverging away from the BNSF alignment to bypass Hanford. The HSR would return to be parallel and adjacent to the BNSF corridor north of Corcoran and follow SR 43 before turning to the east to bypass Corcoran. The route would return to run adjacent to the BNSF alignment south of Corcoran and then diverge to the west near Alpaugh to bypass Allensworth. The alignment would then return to run parallel to the BNSF corridor through Wasco and Shafter before entering Bakersfield. Through Bakersfield, the alignment would broadly follow the BNSF within the limitations of the radii required for HSR operation.

Figure 5.1-1 identifies the subsections used in this description.

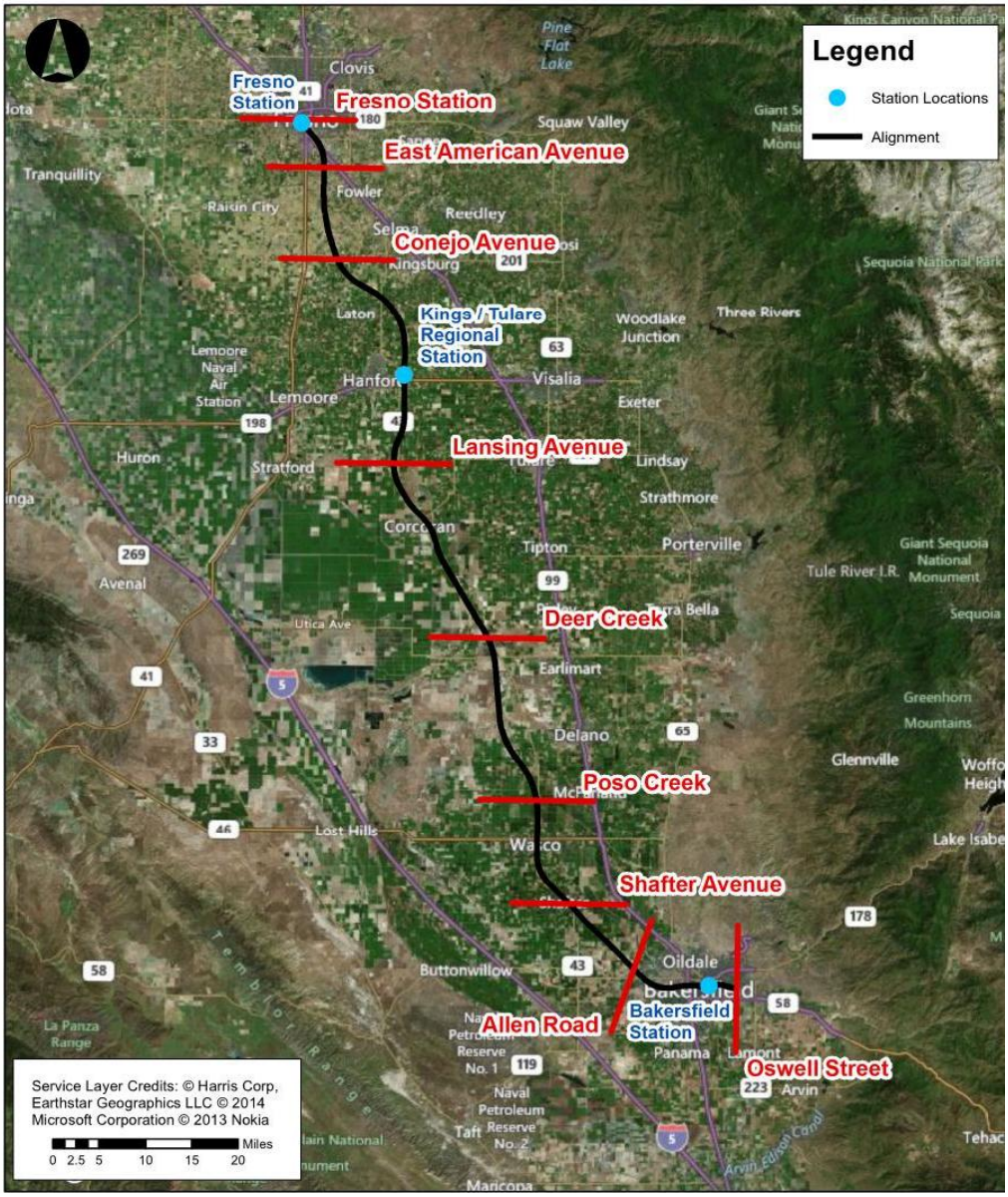

Figure 5.1-1
Overview of Split-Point Locations

5.2 General Constraints

5.2.1 Track Alignment

Through the Central Valley, the track alignment would follow the BNSF where possible, as specified in the 2005 Final Program EIR/EIS for the Proposed California High-Speed Train System.

Whereas a perfectly straight, level path is the most desirable alignment for HSR track design, the horizontal radii used in the HSR alignment have been maximized to the largest practical extent within the site constraints.

5.2.2 Canal and River Vertical Clearances

Clearance over rivers and creeks is designed to allow access beneath the HSR structure for maintenance of the structure and the river banks. Where possible, these clearances have been discussed with and agreed to by the appropriate agencies and irrigation districts.

Clearance over canals and ditches is based on providing a culvert beneath the HSR with a minimum of 6 feet between top-of-rail and top-of-culvert structure.

5.2.3 Separation to Freight Railroads

Where the HSR would run parallel to the BNSF right-of-way, the nearest HSR track would be at least 102 feet away from the BNSF mainline track, center line of track to center line of track.

Where the HSR alignment would cross over the BNSF right-of-way, the design provides a minimum vertical separation of 24 feet. The considerations for the placement of the structural columns and foundations are described in Sections 10.2.3 and 10.2.4.

Where required, conceptual realignments of the BNSF sidings and mainlines are included on the drawings. The design of the realignments would need to be developed with input from BNSF and any relevant third parties.

Where the HSR would run parallel to the UPRR right-of-way, an intrusion protection system would be provided where the separation between the UPRR right-of-way and the nearest HSR track is less than 102 feet.

5.2.4 BNSF Realignments

Where BNSF mainlines would be affected, realignments were designed for 79 miles per hour (mph) design speeds and to be adjacent to the HSR corridor to minimize land impacts. When sidings would be impacted, they also would be relocated.

The BNSF mainlines would be realigned in the vicinity of Bowles, Monmouth (both alignment M), Wasco (alignment WS1), and Bakersfield, (alignment B3) to allow the HSR alignment to meet the design speed to the criteria set forth in TM 2.1.2 and to minimize impacts on properties. BNSF sidings and spur tracks at Conejo Avenue and in the vicinity of Bowles and Monmouth would be reconstructed. Lone Star Spur also would be relocated.

5.2.5 Roadway Vertical Clearances

Where the HSR alignment crosses a roadway, Caltrans *Highway Design Manual* (HDM) (Caltrans, 2012) vertical clearance requirements were used. A minimum of 16.5 feet of vertical clearance would be provided from top of road to the underside of the HSR structure.

Section 6.4 covers clearances for roadways over the HSR.

5.3 Alignment Description

5.3.1 Alignment Description from Fresno Station to East American Avenue (F1)

The Fresno Station would be adjacent to the UPRR corridor at Fresno Street. The alignment would follow the UPRR alignment south out of Fresno before curving away at Orange Avenue to run parallel and adjacent to the BNSF. The alignment would be at-grade, initially passing under SR 41, before entering a shallow trench to pass beneath E Jensen Bypass. The alignment would return to grade before rising on to a viaduct over S Golden State Blvd, a BNSF spur, SR 99, and other local roadways. The alignment would return to grade at E Central Avenue and run adjacent to the BNSF corridor on the western side.

5.3.1.1 Design Speed Reductions

The horizontal geometry at the curve south of Orange Avenue meets exceptional criteria for 220-mph design speeds. The reduced radius curve would minimize impacts on industrial properties and avoid a crossing with three vertical tiers with SR 99, S Cedar Avenue, and the HSR.

5.3.1.2 Reduced Vertical Clearances

Vertical clearances under SR 41 and E Jensen Bypass are approximately 24.5 feet. Reduced clearances would be required to minimize impacts on the existing SR 41 and E Jensen Bypass bridges. Further details and additional constraints are described in Design Variance Request 0012 (revision 2, issued 8/8/12).

5.3.2 Alignment Description from East American Avenue to Conejo Avenue (M/H)

The HSR alignment would run on the west side of, and adjacent to, the BNSF right-of-way between East American Avenue and Conejo Avenue. The alignment would avoid direct impacts to Fowler Packing Company in Bowles, and Chestnut Avenue Landfill in Fresno. Impacts to the Vie Del Company processing plant would be minimized. At the south end of this subsection, the alignment would rise to be elevated as it approaches the crossing of the BNSF right-of-way.

5.3.2.1 BNSF Realignment

The BNSF mainlines would be realigned to the east in the vicinity of Bowles and Monmouth to allow the HSR alignment to meet the design speed to the criteria in TM 2.1.2. In Bowles, the existing BNSF sidings would be reconstructed on the east side of the BNSF mainlines. The BNSF mainline track would be realigned with 102 feet minimum separation to the nearest HSR track centerline.

5.3.3 Alignment Description from Conejo Avenue to Lansing Avenue (H/K4)

South of Conejo Avenue, the alignment would leave the BNSF corridor, diverging to the east. It would cross the Kings River before turning south on the east side of Hanford and SR 43 to follow existing field boundaries where possible. South of the station, the alignment would turn to the west, to be parallel and adjacent to SR 43.

5.3.3.1 HSR Crossing over the BNSF right-of-way

At Conejo Avenue, the alignment would rise to be on aerial structure to cross over the BNSF right-of-way, turning to the east to bypass Hanford on the east. The crossing location has been designed to minimize impacts to the community of Conejo and dairies, while maximizing the length of alignment adjacent to the BNSF transportation corridor. The BNSF sidings in the vicinity of Conejo Avenue would be impacted by the HSR column placement, and would be reconstructed on the opposite side of the BNSF right-of-way.

5.3.3.2 Kings River Complex

Through the Kings River Complex, the HSR would rise up to be on a viaduct to pass over SR 43, Cole Slough, Dutch John Cut, and Kings River. The vertical alignment has been designed to provide 18 feet of clearance above the levees for maintenance purposes. Section 12 discusses these clearances in greater detail. The Kings River levees are owned both by local agencies and USACE.

5.3.3.3 Transmission Line, Dairies, Landfill, and Rendering Facility

South of the Kings River, the alignment parallels the power transmission line adjacent to 7½ Avenue. The alignment location would minimize the bifurcation of agricultural parcels, direct impacts to dairies, and avoid the Kings County Landfill at Hanford Armona Road. The alignment would impact the Baker Commodities Rendering Facility but avoid direct impacts to the waste ponds associated with the facility. Based on meetings between Baker Commodities and the Authority, the processing buildings can be more readily reconstructed than the waste ponds due to permitting issues.

PG&E will relocate the transmission line where it crosses HSR infrastructure and in the vicinity of roadway overpasses. The design will comply with the requirements of the California Public Utilities Commission General Order 95, Rule 37, Table 2.

5.3.3.4 Kings/Tulare Regional Station

The KTR Station would be near the intersection of SR 43 and SR 198. The HSR alignment in this area would be on an aerial structure to pass over San Joaquin Valley Railroad and SR 198. The station would also be on the elevated structure.

5.3.3.5 Ponderosa Community

Adjacent to KTR Station, the alignment impacts the residential community at Ponderosa Road. The alignment location is intended to allow Ponderosa Road to remain in place, thus retaining access to properties on the east side of Ponderosa Road.

5.3.3.6 Kings County Fire Department Heliport

The alignment would pass approximately 800 feet east of the heliport at the Kings County Fire Department Station #4, located adjacent to Houston Avenue. The Federal Aviation Administration Part 77 imaginary surface would not be penetrated by HST facilities or the grade separation of Houston Avenue.

5.3.3.7 Lakeside Cemetery

In the vicinity of Kent Avenue, the alignment would curve to the west. The location and radius has been designed to avoid direct impacts on Lakeside Cemetery.

5.3.3.8 SR 43 Crossing

SR 43 would be lowered to be an underpass beneath the HST alignment in the vicinity of Jersey Avenue. An underpass was selected due to the proximity of the Jersey Avenue intersection, approximately 1,500 feet north of the SR 43 and HST crossing. The SR 43 underpass has a Design Speed of 70 mph and would return to original grade by the intersection with Jersey Avenue. An overpass option with the same design speed would require the Jersey Avenue intersection to be relocated 500 feet to 1,000 feet further north to avoid the intersection occurring on an embankment.

5.3.4 Alignment Description from Lansing Avenue to Deer Creek (K4/C2/P/A1)

South of Lansing Avenue, the alignment would pass over Cross Creek to parallel the BNSF and SR 43 corridor. South of Nevada Avenue, the alignment would leave SR 43 to bypass Corcoran to the east, before returning to parallel the BNSF south of Corcoran. Approaching the BNSF, south of Corcoran, the alignment would rise to be on an elevated structure to cross over SR 43, BNSF, and the Tule River, returning to grade to run parallel on the west side of the BNSF right-of-way.

5.3.4.1 Cross Creek

The alignment would pass through the Cross Creek floodplain on an embankment, rising to be on a viaduct over the designated floodway. The height of the viaduct was designed to provide 16 feet of vertical clearance over the Cross Creek levees, while providing sufficient clearance for access and security beneath the structure throughout its length. Further details of the design considerations in the vicinity of levee systems are provided in Section 12.1.1.

5.3.4.2 Tulare Lakebed Mitigation Site

South of Cross Creek, the elevated structure would continue for the alignment to pass over SR 43 returning to grade and following parallel it on the east side of the Caltrans right-of-way. The HSR corridor would encroach into a lacustrine feature, requiring the exiting berm to be relocated to the east. However, the HSR corridor would not encroach into the Tulare Lakebed Mitigation site.

The lacustrine feature is a potential California Tiger salamander breeding habitat. Construction within the feature would be limited to the dry season and requires implementation of conservation measures in accordance with the USFWS Biological Opinion. Construction must also comply with the mitigation measures identified in the Final EIR/EIS and with the CDFW Incidental Take Permit. Details of the seasonal construction restrictions and mitigation and conservation measures are identified in the Biological Opinion, Incidental Take Permit, and Final EIR/EIS.

5.3.4.3 Salyer Farms Airport

The alignment would pass to approximately 800 feet the east of Salyer Farms Airport runway, located near the intersection of SR 43 and Whitley Avenue. Additionally, Oregon switching station (SWS 512) would be located at least 1,000 feet east of the runway and include a 100-foot tall communications tower. The Federal Aviation Administration Part 77 imaginary surface would not be penetrated by any HST facilities.

5.3.4.4 HSR crossing over BNSF

North of the Tule River, the alignment would be on embankment through the Tule River floodplain, before rising to be on an aerial structure to cross over SR 43, BNSF, and the Tule River. The southern end of the crossing structure is designed to not extend over the BNSF bridge over the Tule River.

5.3.5 Alignment Description from Deer Creek to Poso Creek (A1)

At Deer Creek, the alignment would curve west away from BNSF to avoid direct impacts to numerous cultural and ecological resources. The HSR would rise onto a viaduct to pass over Deer Creek and Stoil Spur. The route would be to the west of Allensworth State Historical Park and Allensworth Ecological Reserve. The location of the alignment would also minimize impacts to vernal pools.

The former Tulare lake bed is known to be in this area; however, no geotechnical data was available during the design of the alignment route. As such the quality of the ground conditions pose a risk to the project cost and schedule.

5.3.6 Alignment Description from Poso Creek to Shafter Avenue (L1/WS1)

The alignment would climb to be on a bridge to cross Poso Creek before returning to embankment south of the creek. Continuing south, the alignment would return to run parallel with the BNSF corridor on the western side. Through and continuing south of Wasco, the

alignment would be on a viaduct and cross over the BNSF. The alignment would return to grade on the east side of the BNSF near Kimberlina Road.

5.3.6.1 Wasco

The alignment climbs onto viaduct through Wasco passing over SR 46, 6th Street, and Poso Avenue. South of Wasco, the alignment curves east crossing the BNSF on viaduct. The curvature of the BNSF is too tight for the HSR to follow on the western side. The alignment returns to embankment in the vicinity of Kimberlina Road on the east side of the BNSF corridor.

Approaching Shafter, a larger offset is provided between the HSR and the BNSF to allow for an additional BNSF mainline track, east of the existing mainline track.

5.3.6.2 Design Speed Reductions

The curve to the South of Wasco would be a minimum radius curve with a design speed of 220 mph. The radius of this curve has been selected to minimize impacts on the agricultural community between Wasco and Shafter.

5.3.6.3 BNSF Realignment

South of Wasco, the BNSF would be realigned to run adjacent to the HSR on the western side. The BNSF realignment is required for the Kimberlina Road grade separation to connect into SR 43 vertically. The position of the HSR alignment in relation to the BNSF would allow for a second BNSF mainline on the east side of the existing BNSF mainline.

5.3.7 Alignment Description from Shafter Avenue to Allen Road (WS1)

The alignment would be elevated through Shafter on the eastern side of the BNSF. South of Shafter, the alignment would cross over the BNSF and descend to embankment to follow the BNSF corridor on the western side. Between Shafter and Bakersfield, the alignment would displace the existing Santa Fe Way which would be realigned to the west to maintain connectivity to the local roads.

5.3.7.1 Shafter

The alignment would climb on to viaduct outside north of Shafter and runs on the eastern side of the BNSF passing over local roadways, floodplains, and BNSF sidings. The alignment would run along a strip of land with industrial sites minimizing impacts to Walker Street and surrounding housing.

5.3.7.2 HSR crossing over BNSF

The HSR alignment crosses over the BNSF south of Shafter. The skew angle and crossing length are minimized by curving the alignment away from the BNSF before curving back towards the BNSF to cross it.

Crossing the BNSF would return the HSR to the western side of the BNSF to avoid impacts to Shafter cemetery and the International Trade Transportation Center near 7th Standard Road.

5.3.7.3 Lone Star Spur

Lone Star spur would be relocated to south of Orange Street, approximately 1 mile north of its current position. The realignment would minimize the length of HSR viaduct and enable a maintenance facility to be proposed in Lone Star spur's existing location.

5.3.8 Alignment Description in Bakersfield – Allen Road to Oswell Street (B3)

South of Allen Road, the alignment would follow the BNSF corridor through Rosedale. The HSR would curve away from the BNSF and rise on to a viaduct at Palm Avenue, crossing over Westside Parkway and the proposed Centennial Corridor (Alternative B). The alignment would cross the BNSF on viaduct west of Gates Canal before paralleling it on the northern side, avoiding the BNSF Bakersfield Yard. The HSR would continue on viaduct crossing SR 99 and Oak Street. The alignment would cross the BNSF once more at G Street, avoiding Bakersfield High School, courthouse, and Convention Center facilities. The HSR station building would be located adjacent to the Amtrak station near SR 204 (Golden State Avenue). East of the station, the alignment would curve to run parallel with the UPRR tracks and Edison Highway on viaduct to Oswell Street.

5.3.8.1 Rosedale Area and BNSF Realignment

The BNSF would be realigned to the north, between approximately Station 6829+81 and 6933+24. The BNSF would run adjacent to HSR on the northern side. HSR would occupy the BNSF right-of-way to avoid direct impacts to Lazy H Mobile Ranch.

5.3.8.2 HSR crossing over BNSF

The HSR would cross the BNSF mainline near Truxtun Avenue, G Street, and H Street. Additionally, the HSR would cross BNSF Spurs near 14th Street.

5.3.8.3 Design Speed Reductions

Due to the constrained urban environment, the design speed through Bakersfield would be reduced. Between Rosedale Highway and the Kern River, the design speed would be limited to 220 mph with exceptional radii on two horizontal curves. Exceptional geometry is required to avoid Flying J oil refinery and Bakersfield commons project.

There would be speed limitations and minimum radii on the curves between Pine Street and the station building. The speed is limited to 125 and 130 mph in this area. The reduced radii would minimize impacts on the BNSF yard, Bakersfield High School, the Kern County Superior Courthouse, and Bakersfield Convention Center facilities.

South of Bakersfield Station, the design speed would be limited to 145 mph. The reduced horizontal radius would minimize impacts on residential properties and Edison Highway.

5.4 Design Requirements

5.4.1 Standards

The track alignment was designed to comply with the following standards:

- TM 2.1.2, Revision 0, Alignment Design Standards for High-Speed Train Operation
- TM 2.1.3, Revision 0, Turnouts and Station Tracks

Where the alignment does not comply with these standards, design variance requests have been produced. Section 16, Design Variances, discusses these variances.

5.4.2 Design Speed

A design speed of 250 mph was achieved where possible. There are areas in the F1, WS1, and B3 alignments where the design speed was reduced to minimize impacts. These speed reductions are discussed in the alignment descriptions above.

5.4.3 Trackbed

The type of trackbed, ballasted or non-ballasted, at each location has not been determined at this time; however, both types would be accommodated by the geometric designs proposed.

5.5 Unique Design and Construction Considerations

In specific locations, permits require additional construction considerations. Section 18 presents a list of permits needed.

Three of the levees at the Kings River Complex are State-Federal Project Levees under the jurisdiction of USACE, the Kings River Conservation District, and CVFPB. Construction of the HSR over these levees would require additional permits and USACE approval.

Irrigation districts prohibit in-channel construction during the irrigation season unless provision is made to maintain irrigation deliveries. CVFPB restricts construction within the floodplain of regulated streams during the designated flood season. Together, the flood and irrigation season cover 12 months; therefore, exemptions would be required.

A permit would be required at the Tulare Lakebed mitigation site and there are limits on the construction period when working near California Tiger Salamander breeding habitats. The alignment description and the EIR/EIS further address this issue.

5.6 Alignment Construction Type

Earthworks were generally specified for embankments up to approximately 15 feet in height. For heights above this and up to approximately 35 feet, retained fill was proposed to minimize the construction footprint. Above 35 feet and where crossing particular features, bridges and viaducts were typically proposed. Table 5.4-1 describes the types of construction proposed along the alignment. The Constructability Assessment Report will provide details on special construction considerations.

Table 5.4-1
Geophysical Limits and Stationing of Alignment Types

Alignment Type	Alignment	Geophysical Limits		Stationing		Miles
		Start	End	Start	End	
At-Grade	F1	North of Stanislaus Street	Florence Ave	257+25	356+65	1.88
Trench	F1	Florence Ave	Orange Ave	356+65	424+25	1.28
Embankment	F1	Orange Ave	North of Golden State Blvd	424+25	431+76	0.14
Retained Fill	F1	North of Golden State Blvd	Golden State Blvd	431+76	439+40	0.14
Aerial	F1	Golden State Blvd	South of SR 99	439+40	503+33	1.21

Alignment Type	Alignment	Geophysical Limits		Stationing		Miles
		Start	End	Start	End	
Retained Fill	F1	South of SR 99	North of Central Ave	503+33	517+30	0.26
Embankment	F1, M	North of Central Ave	South of Willow Ave	517+30	1086+00	10.71
Retained Fill	M, H	South of Willow Ave	North of Conejo Ave	1086+00	1105+70	0.37
Aerial	H	North of Conejo Ave	South of Peach Ave	1105+70	1156+20	0.96
Retained Fill	H	South of Peach Ave	North of Clarkson Ave	1156+20	1173+50	0.33
Embankment	H	North of Clarkson Ave	North of SR 43	1173+50	1439+19	5.03
Retained Fill	H	North of SR 43	SR 43	1439+19	1463+58	0.46
Aerial	H	SR 43	South of Kings River	1463+58	1596+56	2.52
Retained Fill	H	South of Kings River	North of 8th Ave	1596+56	1622+50	0.49
Embankment	H	North of 8th Ave	South of Fargo Ave	1622+50	1850+50	4.32
Retained Fill (one side only)	H	North of Fargo Ave	North of Fargo Ave	1850+50	1852+50	0.04
Embankment	H	North of Fargo Ave	South of Fargo Ave	1852+50	1885+40	0.62
Retained Fill	H	South of Fargo Ave	North of Grangeville Blvd	1885+40	1903+57	0.34
Aerial	H	North of Grangeville Blvd	South of SR 198	1903+57	2008+37	1.98
Retained Fill	H	South of SR 198	North of Hanford Armona Road	2008+37	2023+48	0.29

Alignment Type	Alignment	Geophysical Limits		Stationing		Miles
		Start	End	Start	End	
Embankment	H, K4	North of Hanford Armona Road	SR 43	2023+48	2240+32	5.43
Aerial	K4	SR 43	SR 43	2240+32	2246+03	0.11
Embankment	K4	SR 43	North of Cross Creek	2246+03	2315+00	1.31
Retained Fill (one side only)	K4	North of Kansas Ave	North of Kansas Ave	2315+00	2323+50	0.16
Embankment	K4	North of Kansas Ave	North of Cross Creek	2323+50	2436+00	2.13
Retained Fill	K4	North of Cross Creek	North of Cross Creek	2436+00	2446+81	0.20
Aerial	K4	North of Cross Creek	SR 43	2446+81	2538+71	1.74
Retained Fill	K4	SR 43	South of Lakeland Canal	2538+71	2583+63	0.85
Embankment	K4, C2	South of Lakeland Canal	South of Avenue 152	2583+63	2966+50	7.32
Retained Fill	C2	South of Avenue 152	North of Avenue 144	2966+50	2989+36	0.43
Aerial	C2	North of Avenue 144	Tule River	2989+36	3046+02	1.07
Retained Fill	C2	Tule River	South of Avenue 136	3046+02	3064+70	0.35
Embankment	C2, P, A1	South of Avenue 136	North of Deer Creek	3064+70	3982+20	8.66
Retained Fill	A1	North of Deer Creek	Deer Creek	3982+20	4005+25	0.44
Aerial	A1	Deer Creek	South of Stoil Spur	4005+25	4067+65	1.18
Retained Fill	A1	South of Stoil Spur	South of Stoil Spur	4067+65	4085+95	0.35
Embankment	A1, L1	South of Stoil Spur	South of Sherwood Ave	4085+95	5191+50	16.60

Alignment Type	Alignment	Geophysical Limits		Stationing		Miles
		Start	End	Start	End	
Retained Fill	L1	South of Sherwood Ave	North of Poso Creek	5191+50	5225+40	0.64
Aerial	L1	North of Poso Creek	South of Poso Creek	5225+40	5227+80	0.05
Retained Fill	L1	South of Poso Creek	North of Taussig Ave	5227+80	5271+60	0.83
Embankment	L1, WS1	North of Taussig Ave	North of SR 46	5271+60	5551+00	3.39
Retained Fill	WS1	North of SR 46	SR 46	5551+00	5556+40	0.10
Aerial	WS1	SR 46	SR 46	5556+40	5557+60	0.02
Retained Fill	WS1	SR 46	North of 4th Street	5557+60	5564+80	0.14
Aerial	WS1	North of 4th Street	North of Prospect Ave	5564+80	5682+95	2.24
Retained Fill	WS1	North of Prospect Ave	North of Kimberlina Road	5682+95	5709+50	0.50
Embankment	WS1	North of Kimberlina Road	Kimberlina Road	5709+50	5716+02	0.12
Aerial	WS1	Kimberlina Road	Kimberlina Road	5716+02	5716+70	0.01
Embankment	WS1	Kimberlina Road	South of Fresno Ave	5716+70	5928+55	4.01
Retained Fill	WS1	South of Fresno Ave	North of Shafter Ave	5928+55	5955+30	0.51
Aerial	WS1	North of E Tulare Ave North of Shafter Ave	South of Orange Street	5955+30	6117+25	3.07
Retained Fill	WS1	South of Orange Street	South of Burbank Street	6117+25	6151+00	0.64
Embankment	WS1, B3	South of Burbank Street	Allen Road	6151+00	6805+28	6.95

Alignment Type	Alignment	Geophysical Limits		Stationing		Miles
		Start	End	Start	End	
Aerial	B3	Allen Road	Allen Road	6805+28	6808+46	0.06
Embankment	B3	Allen Road	North of Palm Ave	6808+46	6923+00	2.17
Retained Fill	B3	North of Palm Ave	Palm Ave	6923+00	6930+70	0.15
Aerial	B3	Palm Ave	Oswell Street	6930+70	7430+50	9.47
TOTAL						116.79

5.7 Special Trackwork

The locations of special trackwork are summarized in Table 5.7-1.

Table 5.7-1
Special Trackwork

Trackwork Type	Purpose	Alignment	Location (STA)	Length	Track	Design Speed	Gradient
Turnout	Serves Station	F1	257+24.66	560	NB and SB	110	0.25%
Turnout	Station Storage Tracks	F1	295+04.62	137	NB and SB	25	-0.02%
Turnout	Serves Station	F1	317+24.66	560	NB and SB	110	-0.10%
Crossover	Station/Universal	F1	330+00.00	1140	NB and SB	110	-0.10%
Crossover	Station/Universal	F1	342+90.00	1140	NB and SB	110	-0.10%
Turnout	Serves MOIF	F1	569+84.54	252	SB	50	0.04%
Turnout	Serves MOIF	M	653+70.12	252	SB	50	0.13%
Crossover	Universal	M	891+21.00	1140	NB and SB	110	-0.02%
Crossover	Universal	M	903+59.00	1140	NB and SB	110	-0.02%
Crossover	Station/Universal	H	1835+50.00	1140	NB and SB	110	-0.06%
Crossover	Station/Universal	H	1848+00.00	1140	NB and SB	110	-0.06%
Turnout	Serves Station	H	1919+50.00	560	NB and SB	110	0.50%
Turnout	Station Storage Tracks	H	1941+60.00	137	NB	25	0.00%
Turnout	Station Storage Tracks	H	1957+20.00	137	SB	25	0.00%

Trackwork Type	Purpose	Alignment	Location (STA)	Length	Track	Design Speed	Gradient
Turnout	Serves Station	H	1979+50.00	560	NB and SB	110	-0.33%
Crossover	Station/Universal	H	2046+00.00	1140	NB and SB	110	-0.04%
Crossover	Station/Universal	H	2059+40.00	1140	NB and SB	110	-0.04%
Turnout	Serves MOIS	C2	3088+83.82	252	SB	50	-0.03%
Turnout	Serves MOIS	P	3109+87.01	252	SB	50	-0.03%
Crossover	MOIS/ Universal	P	3134+00.00	1140	NB and SB	110	-0.03%
Crossover	MOIS/ Universal	P	3147+40.00	1140	NB and SB	110	-0.03%
Crossover	Universal	A1	4370+60.00	1140	NB and SB	110	0.10%
Crossover	Universal	A1	4384+00.00	1140	NB and SB	110	0.10%
Crossover	Universal	WS1	5851+60.00	1140	NB and SB	110	0.00%
Crossover	Universal	WS1	5865+10.00	1140	NB and SB	110	0.00%
Turnout	Serves MOIF	WS1	6140+43.00	252	SB	50	-0.82%
Turnout	Serves MOIF	WS1	6219+47.36	252	SB	50	-0.03%
Crossover	Station/Universal	B3	7158+20.00	1140	NB and SB	110	-0.21%
Crossover	Station/Universal	B3	7171+60.00	1140	NB and SB	110	-0.21%
Turnout	Serves Station	B3	7251+95.11	408	NB and SB	80	0.00%

Trackwork Type	Purpose	Alignment	Location (STA)	Length	Track	Design Speed	Gradient
Turnout	Serves Storage Tracks	B3	7277+56.91	137	NB and SB	25	0.00%
Turnout	Serves Station	B3	7299+76.91	560	NB and SB	110	0.00%
Crossover	Station/Universal	B3	7362+50.00	1140	NB and SB	110	0.64%
Crossover	Station/Universal	B3	7375+90.00	1140	NB and SB	110	0.64%

Section 6.0

Roadway Work (Grade Separations) and Other Third-Party Improvements

6.0 Grade Separations and Other Third-Party Improvements

The roadway network impacted by the FB Section falls under the jurisdiction of the following agencies:

- Caltrans
- City of Fresno
- Fresno County
- Kings County
- City of Corcoran
- Tulare County
- Kern County
- City of Shafter
- City of Bakersfield

During the preliminary design phase, the RC liaised with the above agencies to the extent possible and took account of the agencies' comments. The roadway design criteria adopted for roads that would be realigned or reconstructed were based on the agencies' standards. Where no specific standards were cited by the agencies, the following standards were applied:

- Caltrans Highway Design Manual (HDM)
- American Association of State Highway and Transportation Officials (AASHTO) *A Policy on Geometric Design of Highways and Streets*

6.1 Design Speed

Design speeds were developed for each roadway impact based on a combination of factors. Where possible, the design speeds were discussed with the agency responsible for the roadway impacted. The City of Fresno, Fresno County, and Kern County have had the most interaction and coordination on proposed roadway designs and associated design speeds. Kings and Tulare counties provided less input to the application of design criteria and design speeds for impacted roadways.

The resulting design speeds were based upon the following:

- Meetings with agencies, including published local agency design criteria
- Caltrans HDM
- AASHTO, *A Policy on Geometric Design of Highways and Streets*
- General Plans, roadway classification, traffic volumes, existing conditions (number of lanes, posted speeds, horizontal clearances, etc.).

Table 6.1-1 lists roadways that would be impacted by the project together with the jurisdiction and the proposed design speed of each roadway affected by the project. A more detailed explanation for roadway designs where the proposed design speed varies along the same roadway is provided following Table 6.1-1.

Table 6.1-1
Roadway Impacts

No.	Type (Underpass, Overpass, Modification of Closure)	Location (Mid Station Along HSR)	Third Party (Owner)	Design Speed	% Grade	Clearance To HSR	Length (Extent Of Roadway Work)	Street Name	Standards Used
1	Overpass	"F1" 264+72.22	City of Fresno	30	8.00% -6.60%	26.43	1,988.13	Stanislaus Street	City of Fresno/ HDM
2	Closure	"F1" 269+50.00	City of Fresno	30	NA	Bridge Removed	659.13	Tuolumne Street	City of Fresno/ HDM
3	Underpass	"F1" 279+34.87	City of Fresno	30	-7.40% 1.30%	NA	1,448.61	Fresno Street	City of Fresno/ HDM
4	Modification	"F1" 279+35.00	City of Fresno	30	NA	NA	1,000.00	H Street	City of Fresno/ HDM
5	Modification	"F1" 279+35.00	City of Fresno	40	NA	NA	662.00	G Street	City of Fresno/ HDM
6	Underpass	"F1" 288+93.72	City of Fresno	25	-7.00% 8.00%	NA	1,135.06	Tulare Street	City of Fresno/ HDM
7	Modification	"F1" 288+95.00	City of Fresno	40	NA	NA	350.00	G Street	City of Fresno/ HDM
8	Closure	"F1" 293+75.00	City of Fresno	NA	NA	NA	NA	Kern Street	City of Fresno/ HDM

No.	Type (Underpass, Overpass, Modification of Closure)	Location (Mid Station Along HSR)	Third Party (Owner)	Design Speed	% Grade	Clearance To HSR	Length (Extent Of Roadway Work)	Street Name	Standards Used
9	Closure	"F1" 303+50.00	City of Fresno	NA	NA	NA	NA	Mono Street	City of Fresno/ HDM
10	Underpass	"F1" 308+03.84	City of Fresno	25	-5.66% 8.00%	NA	1,788.56	Ventura Street	City of Fresno/ HDM
11	Modification	"F1" 308+05.00	City of Fresno	30	NA	NA	160.00	G Street	City of Fresno/ HDM
12	Modification	"F1" 308+05.00	City of Fresno	30	NA	NA	550.58	H Street	City of Fresno/ HDM
13	Closure	"F1" 338+00.00	City of Fresno	NA	NA	NA	NA	East California Ave	City of Fresno/ HDM
14	Closure	"F1" 340+20.00	City of Fresno	NA	NA	NA	NA	South Cherry Ave	City of Fresno/ HDM
15	Closure	"F1" 347+65.00	City of Fresno	NA	NA	NA	NA	S Lorena Ave	City of Fresno/ HDM
16	Closure	"F1" 351+20.00	City of Fresno	NA	NA	NA	NA	South Van Ness Ave	City of Fresno/ HDM
17	Closure	"F1" 355+70.00	City of Fresno	NA	NA	NA	NA	East Florence Ave	City of Fresno/ HDM

No.	Type (Underpass, Overpass, Modification of Closure)	Location (Mid Station Along HSR)	Third Party (Owner)	Design Speed	% Grade	Clearance To HSR	Length (Extent Of Roadway Work)	Street Name	Standards Used
18	Closure	"F1" 355+70.00	City of Fresno	NA	NA	NA	NA	S Sarah Ave	City of Fresno/ HDM
19	Closure	"F1" 357+95.00	City of Fresno	NA	NA	NA	NA	East Florence Ave	City of Fresno/ HDM
20	Closure	"F1" 364+55.00	City of Fresno	NA	NA	NA	NA	E Belgravia Ave	City of Fresno/ HDM
21	Modification	"F1" 368+00.00	City of Fresno	25	NA	NA	687.24	G Street	City of Fresno/ HDM
22	Modification	"F1" 370+00.00	City of Fresno	25	NA	NA	375.00	E Belgravia Street	City of Fresno/ HDM
23	Modification	"F1" 373+00.00	City of Fresno	50	NA	NA	1,200.00	S Golden State Blvd	City of Fresno/ HDM
24	Overpass	"F1" 373+66.18	City of Fresno	40	7.40% -5.00%	27.04	2,806.61	E Church Ave	City of Fresno/ HDM
25	Modification	"F1" 374+00.00	City of Fresno	25	NA	NA	1,232.72	S East Street	City of Fresno/ HDM
26	Closure	"F1" 380+00.00	City of Fresno	NA	NA	NA	NA	S Railroad Ave	City of Fresno/ HDM

No.	Type (Underpass, Overpass, Modification of Closure)	Location (Mid Station Along HSR)	Third Party (Owner)	Design Speed	% Grade	Clearance To HSR	Length (Extent Of Roadway Work)	Street Name	Standards Used
27	Closure	"F1" 380+40.00	City of Fresno	NA	NA	NA	NA	S East Ave	City of Fresno/ HDM
28	Modification	"F1" 381+00.00	City of Fresno	25	NA	NA	1,130.92	Sunland Ave	City of Fresno/ HDM
29	Closure	"F1" 421+90.00	City of Fresno	NA	NA	NA	NA	S Orange Ave	City of Fresno/ HDM
30	Overpass	"F1" 523+90.49	City of Fresno	35	5.00% -5.00%	27.18	2,600.00	E Central Ave	City of Fresno/ HDM
31	Modification	"F1" 525+00.00	City of Fresno	45	NA	NA	1,154.46	S Cedar Ave	City of Fresno/ HDM
32	Closure	"F1" 550+95.00	City of Fresno	NA	NA	NA	NA	E Malaga Ave	City of Fresno/ HDM
33	Overpass	"F1" 577+34.53	City of Fresno	45	5.00% -5.00%	27.62	2,948.59	E American Ave	City of Fresno/ HDM
34	Overpass	"M" 633+47.39	Fresno County	55	5.00% -5.00%	27.06	3,150.00	E Lincoln Ave	Fresno County/ AASHTO
35	Modification	"M" 633+50.00	Fresno County	55	NA	NA	650.00	S Cedar Ave	Fresno County/ AASHTO

No.	Type (Underpass, Overpass, Modification of Closure)	Location (Mid Station Along HSR)	Third Party (Owner)	Design Speed	% Grade	Clearance To HSR	Length (Extent Of Roadway Work)	Street Name	Standards Used
36	Modification	"M" 633+50.00	Fresno County	55	NA	NA	1,050.00	S Maple Ave	Fresno County/ AASHTO
37	Closure	"M" 659+90.00	Fresno County	NA	NA	NA	NA	E Clayton Ave	Fresno County/ AASHTO
38	Modification	"M" 686+25.00	Fresno County	NA	NA	NA	900.00	S Cedar Ave	Fresno County/ AASHTO
39	Modification	"M" 686+25.00	Fresno County	NA	NA	NA	1,100.00	S Maple Ave	Fresno County/ AASHTO
40	Overpass	"M" 686+26.09	Fresno County	55	5.00% -5.00%	27.13	3,200.00	E Adams Ave	Fresno County/ AASHTO
41	Overpass	"M" 739+08.24	Fresno County	55	5.00% -5.00%	27.66	3,250.00	E South Ave	Fresno County/ AASHTO
42	Modification	"M" 739+00.00	Fresno County	55	NA	NA	700.00	S Cedar Ave	Fresno County/ AASHTO
43	Modification	"M" 739+00.00	Fresno County	55	NA	NA	1,050.00	S Maple Ave	Fresno County/ AASHTO
44	Overpass	"M" 791+99.94	Fresno County	55	5.00% -5.00%	27.22	3,100.00	E Manning Ave	Fresno County/ AASHTO

No.	Type (Underpass, Overpass, Modification of Closure)	Location (Mid Station Along HSR)	Third Party (Owner)	Design Speed	% Grade	Clearance To HSR	Length (Extent Of Roadway Work)	Street Name	Standards Used
45	Modification	"M" 792+00.00	Fresno County	55	NA	NA	1,000.00	S Maple Ave	Fresno County/ AASHTO
46	Closure	"M" 818+49.00	Fresno County	NA	NA	NA	NA	E Springfield Ave	Fresno County/ AASHTO
47	Overpass	"M" 898+64.57	Fresno County	65	5.00% -4.90%	28.39	3,900.00	E Floral Ave	Fresno County/ AASHTO
48	Closure	"M" 952+25.00	Fresno County	NA	NA	NA	NA	E Topeka Ave	Fresno County/ AASHTO
49	Overpass	"M" 955+94.58	Fresno County	65	4.50% -4.30%	29.89	4,460.00	E Nebraska Ave	Fresno County/ AASHTO
50	Modification	"M" 995+00.00	Fresno County	65	NA	NA	3,326.39	S Chestnut Ave (N) at (MV)	Fresno County/ AASHTO
51	Overpass	"M" 1007+79.74	Fresno County	65	4.50% -4.50%	29.35	4,000.00	E Mountain View Ave	Fresno County/ AASHTO
52	Modification	"M" 1015+00.00	Fresno County	55	NA	NA	1,600.00	S Chestnut Ave (S) at (MV)	Fresno County/ AASHTO
53	Closure	"H" 1180+25.00	Fresno County	NA	NA	NA	NA	E Clarkson Ave	Fresno County/ AASHTO

No.	Type (Underpass, Overpass, Modification of Closure)	Location (Mid Station Along HSR)	Third Party (Owner)	Design Speed	% Grade	Clearance To HSR	Length (Extent Of Roadway Work)	Street Name	Standards Used
54	Modification	"H" 1190+00.00	Fresno County	55	NA	NA	3,277.19	Clarkson - Minnewawa Connector	Fresno County/ AASHTO
55	Closure	"H" 1198+00.00	Fresno County	NA	NA	NA	NA	S Minnewawa Ave	Fresno County/ AASHTO
56	Overpass	"H" 1224+90.80	Fresno County	65	4.50% -4.50%	30.24	4,400.00	S Clovis Ave	Fresno County/ AASHTO
57	Overpass	"H" 1250+51.28	Fresno County	65	5.00% -4.90%	31.39	3,800.00	E Elkhorn Ave	Fresno County/ AASHTO
58	Overpass	"H"1289+37.98	Fresno County	65	5.00% -5.00%	31.63	5,100.00	S Fowler Ave	Fresno County/ AASHTO
59	Overpass	"H" 1351+01.06	Fresno County	65	4.50% -4.50%	28.88	3,900.00	E Davis Ave	Fresno County/ AASHTO
60	Underpass	"H" 1645+00.00	Kings County	55	5.00% -5.00%	NA	1,900.00	8th Ave North (at Dover)	Kings County/ HDM
61	Overpass	"H" 1654+01.38	Kings County	55	5.00% -5.00%	28.81	3,600.00	Dover Ave	Kings County/ HDM
62	Overpass	"H" 1706+67.67	Kings County	55	4.00% -4.00%	28.82	3,800.00	Excelsior Ave	Kings County/ HDM

No.	Type (Underpass, Overpass, Modification of Closure)	Location (Mid Station Along HSR)	Third Party (Owner)	Design Speed	% Grade	Clearance To HSR	Length (Extent Of Roadway Work)	Street Name	Standards Used
63	Overpass	"H" 1760+97.63	Kings County	55	5.00% -5.00%	28.49	3,600.00	Elder Ave	Kings County/ HDM
64	Overpass	"H" 1814+88.45	Kings County	60	3.00% -3.00%	29.08	4,600.00	Flint Ave	Kings County/ HDM
65	Overpass	"H" 1868+17.25	Kings County	55	5.00% -5.00%	29.12	3,600.00	Fargo Ave	Kings County/ HDM
66	Modification	"H" 1870+00.00	Kings County	55	NA	NA	1,155.95	7½ Ave	Kings County/ HDM
67	Modification	"H" 1870+00.00	Kings County	25	NA	NA	1,344.31	7½ Ave Connector	Kings County/ HDM
68	Overpass	"H" 2029+28.99	Kings County	55	5.00% -5.00%	30.88	3,476.10	Hanford Armona Road	Kings County/ HDM
69	Overpass	"H" 2083+93.12	Kings County	55	4.00% -4.00%	28.64	3,400.00	Houston Ave	Kings County/ HDM
70	Overpass	"H" 2136+82.40	Kings County	55	5.00% -5.00%	29.17	3,501.65	Iona Ave	Kings County/ HDM
71	Overpass	"K4" 2120+05.79	Kings County	55	5.00% -5.00%	27.71	3,600.00	Idaho Ave	Kings County/ HDM

No.	Type (Underpass, Overpass, Modification of Closure)	Location (Mid Station Along HSR)	Third Party (Owner)	Design Speed	% Grade	Clearance To HSR	Length (Extent Of Roadway Work)	Street Name	Standards Used
72	Overpass	"K4" 2173+32.90	Kings County	55	5.00% -5.00%	27.23	3,600.00	Jackson Ave	Kings County/ HDM
73	Closure	"K4" 2227+50.00	Kings County	NA	NA	NA	NA	Jersey Ave	Kings County/ HDM
74	Underpass	"K4" 2242+13.82	Kings County	70	-2.75% 2.75%	NA	4,200.00	SR 43 (Jersey Ave)	Kings County/ HDM
75	Overpass	"K4" 2289+20.77	Kings County	45	3.90% -5.00%	27.35	3,900.00	Kent Ave	Kings County/ HDM
76	Overpass	"K4" 2343+94.80	Kings County	60	3.00% -3.00%	28.18	5,350.00	Kansas Ave	Kings County/ HDM
77	Closure	"K4" 2395+00.00	Kings County	NA	NA	NA	NA	Lansing Ave	Kings County/ HDM
78	Overpass	"C2" 2622+21.78	Kings County	50	4.00% -4.00%	27.13	3,700.00	Nevada Ave	Kings County/ HDM
79	Closure	"C2" 2703+50.00	Kings County	NA	NA	NA	NA	Newark Ave	Kings County/ HDM
80	Closure	"C2" 2719+00.00	Kings County	NA	NA	NA	NA	5 ½ Ave	Kings County/ HDM

No.	Type (Underpass, Overpass, Modification of Closure)	Location (Mid Station Along HSR)	Third Party (Owner)	Design Speed	% Grade	Clearance To HSR	Length (Extent Of Roadway Work)	Street Name	Standards Used
81	Closure	"C2" 2727+50.00	Kings County	NA	NA	NA	NA	Niles Ave	Kings County/ HDM
82	Overpass	"C2" 2760+67.70	Kings County	45	5.00% -4.70%	27.23	3,213.27	Corcoran Highway	Kings County/ HDM
83	Modification	"C2" 2764+00.00	Kings County	NA	NA	NA	NA	Orange Ave	Kings County/ HDM
84	Closure	"C2" 2800+00.00	Kings County	NA	NA	NA	NA	4 ½ Ave	Kings County/ HDM
85	Underpass	"C2" 2813+20.63	Caltrans	55	-2.30% 3.00%	NA	2,300.00	Whitley Ave (SR 137)	HDM
86	Closure	"C2" 3056+00.00	Kings County	NA	NA	NA	NA	Avenue 136	Kings County/ HDM
87	Overpass	"P" 3123+80.43	Tulare County	50(40*)	4.57% -4.38%	27.33	3,112.58	Avenue 128	Tulare County/ AASHTO
88	Overpass	"P" 3171+12.73	Tulare County	50(45*)	5.00% -5.00%	27.06	4,000.46	Hesse Ave	Tulare County/ AASHTO
89	Overpass	"P" 3232+97.60	Tulare County	50(45*)	5.00% -5.00%	27.21	3,911.37	Avenue 112	Tulare County/ AASHTO

No.	Type (Underpass, Overpass, Modification of Closure)	Location (Mid Station Along HSR)	Third Party (Owner)	Design Speed	% Grade	Clearance To HSR	Length (Extent Of Roadway Work)	Street Name	Standards Used
90	Closure	"P" 3242+50.00	Tulare County	NA	NA	NA	NA	Angiola Dr	Tulare County/ AASHTO
91	Overpass	"P" 3432+67.43	Tulare County	50(40*)	4.60% -4.50%	28.68	3,530.15	Avenue 88	Tulare County/ AASHTO
92	Overpass	"A1" 4118+11.64	Tulare County	50	4.57% 4.72%	27.77	3,200.00	County Road J22 (Ave 56)	Tulare County/ AASHTO
93	Closure	"A1" 4330+50.00	Tulare County	NA	NA	NA	NA	Avenue 24	Tulare County/ AASHTO
94	Closure	"A1" 4488+50.00	Tulare County	NA	NA	NA	NA	Road 80	Tulare County/ AASHTO
95	Modification	"A1" 4540+00.00	Kern County	45(35*)	NA	NA	NA	Schofield Ave	Kern County/ HDM
96	Overpass	"A1" 4597+88.13	Kern County	65	4.00% -4.00%	28.04	4,349.44	Garces Highway	Kern County/ HDM
97	Closure	"A1" 4657+00.00	Kern County	NA	NA	NA	NA	Woollomes Ave	Kern County/ HDM
98	Modification	"A1" 4775+00.00	Kern County	45(35*)	NA	NA	4,924.78	Magnolia Ave	Kern County/ HDM

No.	Type (Underpass, Overpass, Modification of Closure)	Location (Mid Station Along HSR)	Third Party (Owner)	Design Speed	% Grade	Clearance To HSR	Length (Extent Of Roadway Work)	Street Name	Standards Used
99	Modification	"A1" 4780+00.00	Kern County	45	NA	NA	1,170.00	Magnolia Ave (South)	Kern County/ HDM
100	Overpass	"A1" 4782+77.92	Kern County	65	4.22% -4.11%	28.30	4,655.00	Pond Road	Kern County/ HDM
101	Overpass	"A1" 4848+99.49	Kern County	65	4.00% -4.00%	28.95	4,689.94	Peterson Road	Kern County/ HDM
102	Closure	"A1" 4907+00.00	Kern County	NA	NA	NA	NA	Elmo Highway	Kern County/ HDM
103	Overpass	"WS1" 5497+36.93	Kern County	65	4.00% -4.00%	27.71	6,000.00	McCombs Ave	Kern County/ HDM
104	Modification	"WS1" 5504+00.00	Kern County	25	NA	NA	678.87	McCombs Connector	Kern County/ HDM
105	Modification	"WS1" 5504+00.00	Kern County	25	NA	NA	500.00	Annin Connector	Kern County/ HDM
106	Underpass	"WS1" 5716+36.56	Kern County	55	-3.00% 3.00%	NA	1,408.34	Kimberlina Road	Kern County/ HDM
107	Overpass	"WS1" 5835+83.89	City of Shafter	55	5.00% -5.00%	27.71	4,378.95	Merced Ave	City of Shafter/ HDM

No.	Type (Underpass, Overpass, Modification of Closure)	Location (Mid Station Along HSR)	Third Party (Owner)	Design Speed	% Grade	Clearance To HSR	Length (Extent Of Roadway Work)	Street Name	Standards Used
108	Overpass	"WS1" 5883+33.10	City of Shafter	55	5.00% -5.00%	27.96	3,550.00	Poplar Ave	City of Shafter/ HDM
109	Modification	"WS1" 5895+00.00	City of Shafter	35	NA	NA	880.32	Poplar Connector	City of Shafter/ HDM
110	Overpass	"WS1" 5921+60.21	City of Shafter	55	5.00% -5.00%	29.03	4,712.85	Fresno Ave	City of Shafter/ HDM
111	Modification	"WS1" 6112+00.00	Kern County	65	NA	NA	1,000.00	Cherry Ave	Kern County/ HDM
112	Modification	"WS1" 6135+00.00	City of Shafter	25	NA	NA	550.00	Burbank Connector	City of Shafter/ HDM
113	Overpass	"WS1" 6145+30.00	City of Shafter	55	5.00% -5.00%	29.26	4,700.00	Burbank Ave	City of Shafter/ HDM
114	Overpass	"WS1" 6293+37.64	Kern County	55	5.00% -4.31%	27.16	2,700.00	7th Standard Road	Kern County/ HDM
115	Modification	"WS1" 6395+00.00	City of Bakersfield	30	NA	NA	990.85	Kratzmeyer Connector	City of Bakersfield/ HDM
116	Overpass	"WS1" 6404+97.05	City of Bakersfield	55	5.00% -5.00%	27.33	3,500.00	Kratzmeyer Road	City of Bakersfield/ HDM

No.	Type (Underpass, Overpass, Modification of Closure)	Location (Mid Station Along HSR)	Third Party (Owner)	Design Speed	% Grade	Clearance To HSR	Length (Extent Of Roadway Work)	Street Name	Standards Used
117	Closure	"WS1" 6444+00.00	Kern County	NA	NA	NA	NA	Reina Road	Kern County/ HDM
118	Modification	"WS1" 6460+00.00	Kern County	30	NA	NA	659.21	Noriega Road	Kern County/ HDM
119	Overpass	"WS1" 6462+13.59	Kern County	65	4.00% -4.00%	30.08	5,650.00	Renfro Road	Kern County/ HDM
120	Modification	"WS1" 6470+00.00	Kern County/ Bakersfield	65	NA	NA	44,907.77	Santa Fe Way	Kern/ City of Bakersfield/ HDM
121	Modification	"B3" 6800+00.00	City of Bakersfield	40	-3.15% 3.50%	NA	1,629.12	Santa Fe Way	City of Bakersfield/ HDM
122	Modification	"B3" 6875+00.00	City of Bakersfield	25		NA	1,400.00	Lone Oak Drive	City of Bakersfield/ HDM
123	Overpass	"B3" 6880+19.10	City of Bakersfield	55	5.00% -5.00%	27.89	3,500.00	Rosedale Highway	City of Bakersfield/ HDM
124	Modification	"B3" 6881+00.00	City of Bakersfield	25	NA	NA	673.20	Jewetta Ave	City of Bakersfield/ HDM
125	Modification	"B3" 6905+00.00	City of Bakersfield	25	NA	NA	1,500.00	Enger Street	City of Bakersfield/ HDM

No.	Type (Underpass, Overpass, Modification of Closure)	Location (Mid Station Along HSR)	Third Party (Owner)	Design Speed	% Grade	Clearance To HSR	Length (Extent Of Roadway Work)	Street Name	Standards Used
126	Closure	"B3" 6914+50.00	City of Bakersfield	NA	NA	NA	NA	Verdugo Lane Glenn Street	City of Bakersfield/ HDM
127	Modification	"B3" 6925+00.00	City of Bakersfield	25	NA	NA	648.63	Verdugo Lane	City of Bakersfield/ HDM
128	Closure	"B3" 6930+00.00	City of Bakersfield	NA	NA	NA	NA	Palm Ave	City of Bakersfield/ HDM
129	Modification	"B3" 6949+00.00	City of Bakersfield	25	NA	NA	692.68	Slikker Drive	City of Bakersfield/ HDM
130	Modification	"B3" 6952+00.00	City of Bakersfield	25	NA	NA	327.58	Art Street	City of Bakersfield/ HDM
131	Modification	"B3" 6954+00.00	City of Bakersfield	25	NA	NA	429.74	Shellebarger Ave	City of Bakersfield/ HDM
132	Modification	"B3" 6991+00.00	City of Bakersfield	55	NA	NA	1,740.74	Brimhall Road	City of Bakersfield/ HDM
133	Modification	"B3" 7015+00.00	City of Bakersfield	50	5.00% -2.30%	NA	2,282.18	Westside Pkwy – Coffee Road off ramp	City of Bakersfield/ HDM
134	Closure	"B3" 7217+40.00	City of Bakersfield	NA	NA	NA	NA	Eye Street	City of Bakersfield/ HDM

No.	Type (Underpass, Overpass, Modification of Closure)	Location (Mid Station Along HSR)	Third Party (Owner)	Design Speed	% Grade	Clearance To HSR	Length (Extent Of Roadway Work)	Street Name	Standards Used
135	Closure	"B3" 7252+00.00	City of Bakersfield	NA	NA	NA	NA	S Street	City of Bakersfield/ HDM
136	Closure	"B3" 7274+00.00	City of Bakersfield	NA	NA	NA	NA	Chico Street	City of Bakersfield/ HDM
137	Closure	"B3" 7279+00.00	City of Bakersfield	NA	NA	NA	NA	Inyo Street	City of Bakersfield/ HDM
138	Closure	"B3" 7283+00.00	City of Bakersfield	NA	NA	NA	NA	Dolores Street	City of Bakersfield/ HDM
139	Closure	"B3" 7290+00.00	City of Bakersfield	NA	NA	NA	NA	Kern Street	City of Bakersfield/ HDM
140	Closure	"B3" 7292+56.00	City of Bakersfield	NA	NA	NA	NA	Eureka Street	City of Bakersfield/ HDM
141	Closure	"B3" 7300+30.00	City of Bakersfield	NA	NA	NA	NA	King Street	City of Bakersfield/ HDM
142	Closure	"B3" 7301+00.00	City of Bakersfield	NA	NA	NA	NA	E 18th Street	City of Bakersfield/ HDM
143	Closure	"B3" 7323+00.00	City of Bakersfield	NA	NA	NA	NA	E 21st Street	City of Bakersfield/ HDM
* Will require reduced design speed at horizontal curves. At Nevada Avenue, reduced design speed on horizontal curve approaching stop condition.									

The following roadways would have varying design speeds:

Avenue 128 (P) – Two different design speeds are indicated for different portions of the roadway, 50 mph and 40 mph. The 10-mph speed difference is due to the differing curve radii used, as indicated in Table 6.1-2. Avenue 128 terminates at SR 43 with a "T" intersection that is stop controlled. The 40-mph design speed was developed near the T intersection to lessen the acquisition impacts to the adjacent farm land. The proposed geometry has a 200-foot-long tangent that separates the curve with an approximate 150-degree delta angle and 425-foot radius from the stopped condition. The curve radii for the remaining portion of this road are both 700-foot radius curves that support a 50-mph design speed.

Avenue 120 (Hesse Avenue) (P) – Two different design speeds are indicated for different portions of the roadway, 50 mph and 45 mph. The 5-mph speed difference is due to the differing curve radii used, as indicated in Table 6.1-2. Hesse Avenue forms a T intersection that is stop controlled at the intersection with existing Hesse Avenue. The 45-mph design speed was developed near the T intersection to lessen the acquisition impacts to the adjacent farm land. The proposed geometry has a 400-foot-long tangent that separates the radius curve with an approximate 90-degree delta angle and 550-foot radius from the stopped condition. The other curve radius for this road is a 700-foot radius curves that supports a 50-mph design speed.

Avenue 112 (P) – Two different design speeds are indicated for different portions of the roadway, 50 mph and 45 mph. The 5-mph speed difference is due to the differing curve radii used, as indicated in Table 6.1-2. Avenue 112 forms a T intersection that is stop controlled at the intersection with the proposed Avenue 112 Connector Road. The 45-mph design speed was developed near the T intersection to lessen the acquisition impacts to the adjacent farm land. The proposed geometry has a 400-foot-long tangent that separates the curve with an approximate 90-degree delta angle and 550-foot radius from the stopped condition. The other curve radius for this road is a 700-foot radius curves that supports a 50-mph design speed.

Avenue 88 (P) – Two different design speeds are indicated for different portions of the roadway, 50 mph and 40 mph. The 10-mph speed difference is due to the differing curve radii used, as indicated in Table 6.1-2. Avenue 88 terminates at Avenue 88 Connector Road with a T intersection that is stop controlled. The 40-mph design speed was developed near the T intersection to lessen the acquisition impacts to the adjacent farm land. The proposed geometry has a 200-foot-long tangent that separates the curve with an approximate 90-degree delta angle and 425-foot radius from the stopped condition. The curve radii for the remaining portion of this road are both 700-foot radius curves that support a 50-mph design speed.

Scofield Avenue (A1) - Two different design speeds are indicated for different portions of the roadway, 45 mph and 35 mph. The 10-mph speed difference is due to the differing curve radii used, as indicated in Table 6.1-2. Scofield Avenue terminates at Garces Highway with a T intersection that is stop controlled. The 35-mph design speed was developed near the T intersection to lessen the acquisition impacts to the adjacent farm land. The proposed geometry has a 200-foot-long tangent that separates the curve with an approximate 90-degree delta angle and 425-foot radius from the stopped condition. The curve radii for the remaining portion of this road are both 700-foot radius curves that support a 45-mph design speed.

Magnolia Avenue (A1) - Two different design speeds are indicated for different portions of the roadway, 45 mph and 35 mph. The 10-mph speed difference is due to the differing curve radii used, as indicated in Table 6.1-2. Magnolia Avenue terminates at Pond Road with a T intersection that is stop controlled. The 35-mph design speed was developed near the T intersection to lessen the acquisition impacts to the adjacent farm land. The proposed geometry has a 20-foot-long tangent that separates the curve with an approximate 90-degree delta angle and 425-foot radius from the stopped condition. There is another 425-foot radius curve where Magnolia Avenue

passes under the Pond Road overpass. The curve radii for the remaining portion of this road are 700-foot or greater radius curves that support a 45-mph design speed.

Table 6.1-2
Roadway Horizontal Alignment Summary for Roadways with Varying Speed Limits

Street Name	Criteria	Design Speed mph	Radius Ft	F Side Friction Factor	Calculated "e" Superelevation
Avenue 128 (P)	AASHTO	40	425	0.160	9.2%
Avenue 128 (P)	AASHTO	50	700	0.140	9.9%
Hesse Avenue (P)	AASHTO	45	550	0.150	9.7%
Hesse Avenue (P)	AASHTO	50	700	0.140	9.9%
Avenue 112 (P)	AASHTO	45	550	0.150	9.7%
Avenue 112 (P)	AASHTO	50	700	0.140	9.9%
Avenue 88 (P)	AASHTO	40	425	0.160	9.2%
Avenue 88 (P)	AASHTO	50	700	0.140	9.9%
Schofield Ave (A1)	HDM	35	425	0.155	3.8%
Schofield Ave (A1)	HDM	45	700	0.145	4.9%
Magnolia Ave (A1)	HDM	35	425	0.155	3.8%
Magnolia Ave (A1)	HDM	45	700	0.145	4.9%

6.2 Side Slopes

Caltrans side slope standards were applied to the design of the embankment and cut slopes necessary for the roadway improvements. Typically, side slopes with a ratio of 4 horizontal to 1 vertical (4H:1V) would be utilized. In constrained areas, steeper side slopes up to 2H:1V would be used. Where roadway side slopes were required to be steeper than 4H:1V, due to land limitations or the need to mitigate the extent of encroachments onto adjoining parcels, appropriate roadside safety measures would be incorporated (e.g. guard rails; retaining walls with barrier rails). Where bridge abutment fill slopes are used, a 1.5H:1V paved slope would be used per the Caltrans HDM, *Memo to Designers and Bridge Design Details* (Section 6, pages 6 through 21).

6.3 Typical Roadway Cross-Sections

A minimum roadway right-of-way width of 60 feet was designated for local roadways. The minimum 60-foot right-of-way provides for two 12-foot travel lanes, two paved shoulders (4-foot minimum, 8-foot maximum) and 4H:1V side slopes. The proposed roadway right-of-way was determined by the width of the roadway embankment or cut. For embankments, an additional right-of-way allowance was made for a 30-foot-wide drainage swale beyond the toe of the embankment and an additional 5 feet minimum buffer outside of the swale. For sections with no swale, the roadway right-of-way was located a minimum of 5 feet from the toe of the embankment.

For cut sections, the roadway right-of-way was located a minimum of 5 feet from the top of the cut. Temporary construction easements (TCE) were allowed for construction work outside of these limits. TCEs were applied outside the roadway rights-of-way wherever driveways required reconstruction and wherever retaining walls were preferred instead of embankment slopes.

6.4 Vertical Clearances

Vertical clearances between roadways and the undersides of HSR structures conform to the standards set down by Caltrans in their HDM Index 309.2(1).

Vertical clearances between the HSR tracks and the undersides of roadway structures crossing over the HSR were based on design criteria set down in TM 1.1.21.

Clearances over UPRR, BNSF, San Joaquin Valley Railroad, and spur tracks are per the *BNSF Railway – Union Pacific Railroad Guidelines for Railroad Grade Separation Projects (BNSF-UPRR, 2007)*.

Table 6.4-1 lists the vertical clearance standards by type of crossing.

Table 6.4-1
Vertical Clearance by Crossing Type

Type of Crossing	Minimum Vertical Clearance (feet, inches)
Roadway over HSR (a)	27'-0"
HSR over Roadway (b)	16'-6" *
Roadway over Roadway (b)	16'-6" *
Roadway over UPRR/BNSF (c)	24'-0"
UPRR/BNSF over Roadway (c)	17'-6"
* Clearance of 15'-0" allowed over minor local roadways. (a) CHSTP standard (b) Caltrans HDM Standard (c) BNSF-UPRR, 2007	

6.5 Horizontal Clearances

The Caltrans requirements for horizontal clearances to roadside objects and the HSR were followed. Clear Recovery Zone requirements were followed to determine minimum horizontal clearances to a fixed object (Clear Zone Width).

Table 6.5-1 lists the horizontal clearance requirements for the Clear Zone Width and for the proposed HSR utilized in the roadway design approach.

Table 6.5-1
Horizontal Clearance by Roadway Facility

Roadway Facility	Minimum Clear Zone Width (feet)	Minimum Horizontal Clearance to HSR (feet)
Freeways and Expressways	30	52
Conventional Highways	20	52
Local Roadways (Speed limit less than 40 mph)	20	52
Local Roadways (Speed limit 40 mph or less)	HDM Index 309.1(3)(c)	HDM Index 309.1(3)(c)

6.6 Grade Separations/Roadway Closures

The HSR profile includes below-grade sections, at-grade sections and elevated sections on viaducts. Roadways intersected by the HSR at-grade would be either grade separated or permanently closed to through traffic. Direct coordination with agencies affected by the HSR Project determined which roadways would remain open to traffic and which would be closed. For roadways that would be closed, the end of the roadway at the HSR right-of-way boundary would become a cul-de-sac or other dead-end treatment applied according to the design criteria of the local jurisdiction. In certain cases, it was appropriate to realign the roadway so that it would connect to a nearby roadway that would have a grade-separated crossing of the HSR alignment.

Table 6.6-1 provides a summary of proposed roadway closures.

Table 6.6-1
Roadway Closures

Alignment Subsection	Roadway Name	HSR Mainline Station
F1 - FRESNO	Tuolumne Street	269+50.00
F1 – FRESNO	Kern Street	293+75.00
F1 – FRESNO	Mono Street	303+50.00
F1 – FRESNO	East California Ave	338+00.00
F1 – FRESNO	South Cherry Ave	340+20.00
F1 – FRESNO	S Lorena Ave	347+65.00
F1 – FRESNO	South Van Ness Ave	351+20.00
F1 – FRESNO	East Florence Ave	355+70.00
F1 – FRESNO	S Sarah Ave	355+70.00
F1 – FRESNO	East Florence Ave	357+95.00
F1 – FRESNO	E Belgravia Ave	364+55.00

Alignment Subsection	Roadway Name	HSR Mainline Station
F1 – Fresno	S Railroad Ave	380+00.00
F1 – Fresno	S East Ave	380+40.00
F1 – Fresno	S Orange Ave	421+90.00
F1 - Fresno	E Malaga Ave	550+95.00
M - Monmouth	E Clayton Ave	660+10.00
M - Monmouth	E Springfield Ave	818+49.00
M - Monmouth	E Topeka Ave	952+25.00
H - Hanford	E Clarkson Ave	1180+25.00
H - Hanford	S Minnewawa Ave	1198+00.00
K4 - Kaweah	Jersey Ave	2227+50.00
K4 - Kaweah	Lansing Ave	2395+00.00
C2 - Corcoran	Newark Ave	2708+50.00
C2 - Corcoran	5½ Ave	2719+00.00
C2 - Corcoran	Niles Ave	2727+50.00
C2 - Corcoran	4½ Ave	2800+00.00
C2 - Corcoran	Avenue 136	3056+00.00
P - Pixley	Angiola Drive	3242+50.00
A1 - Allensworth	Avenue 24	4330+50.00
A1 - Allensworth	Road 80	4488+50.00
A1 - Allensworth	Woollomes Ave	4657+00
A1 - Allensworth	Elmo Highway	4907+07
WS1 – Wasco Shafter	Reina Road	6444+00.00
B3 - Bakersfield	Verdugo Lane	6914+50.00
B3 – Bakersfield	Palm Ave	6930+00.00
B3 – Bakersfield	Eye Street	7217+40.00
B3 – Bakersfield	S Street	7252+00.00
B3 – Bakersfield	Chico Street	7274+00.00

Alignment Subsection	Roadway Name	HSR Mainline Station
B3 – BAKERSFIELD	Inyo Street	7279+00.00
B3 – BAKERSFIELD	Dolores Street	7283+00.00
B3 – BAKERSFIELD	Kern Street	7290+00.00
B3 – BAKERSFIELD	Eureka Street	7292+56.00
B3 – BAKERSFIELD	King Street	7300+30.00
B3 – BAKERSFIELD	E 18th Street	7301+00.00
B3 - BAKERSFIELD	E 21st Street	7323+00.00

Table 6.6-2 provides a tabulation of proposed railroad crossing modifications.

Table 6.6-2
At-Grade Railroad Crossing Impacts

Street	Station	Comment
Tuolumne Street	"F1" 269+50.00	Grade separated crossing removed
Tulare Street	"F1" 289+00.00	New Underpass, remove crossing
Kern Street	"F1" 294+00.00	Remove at-grade crossing
Mono Street	"F1" 303+00.00	Remove at-grade crossing
Ventura Street	"F1" 308+00.00	New Underpass, remove crossing
S Van Ness Ave	"F1" 351+00.00	Remove at-grade crossing
E Florence Ave	"F1" 358+00.00	Remove at-grade crossing
E Church Ave	"F1" 374+00.00	New Overpass, remove crossing
E Central Ave	"F1" 524+00.00	New Overpass, remove crossing
E American Ave	"F1" 577+00.00	New Overpass, remove crossing
E Lincoln Ave	"M" 633+47.39	New Overpass, remove crossing
E Clayton Ave	"M" 659+90.00	Remove at-grade crossing
E Adams Ave	"M" 686+26.09	New Overpass, remove crossing
E South Ave	"M" 739+08.24	New Overpass, remove crossing
E Manning Ave	"M" 791+99.94	New Overpass, remove crossing
E Springfield Ave	"M" 818+49.00	Remove at-grade crossing
E Floral Ave	"M" 898+64.57	New Overpass, remove crossing
E Nebraska Ave	"M" 955+94.58	New Overpass, remove crossing
S Chestnut Ave	"M" 996+00.00	Remove at-grade crossing

Street	Station	Comment
E Mountain View Ave	"M" 1007+80.00	New Overpass, remove crossing
E Conejo Ave	"H" 1120+00.00	Modify Crossing Arms
Nevada Ave	"C2" 2622+21.78	New Overpass, remove crossing, place new at-grade crossing
Corcoran Highway	"C2" 2760+67.70	New Overpass, remove crossing
Avenue 136	"C2" 3056+00.00	Remove at-grade crossing
Avenue 128	"P" 3123+80.43	New Overpass, remove crossing
Hesse Ave	"P" 3171+12.73	New Overpass, remove crossing
Avenue 112	"P" 3232+97.60	New Overpass, remove crossing
Avenue 88	"P" 3432+67.43	New Overpass, remove crossing
McCombs Ave	"WS1" 5504+00.00	New Overpass, remove crossing
Kimberlina Road	"WS1" 5715+00.00	New Underpass, remove crossing
Merced Ave	"WS1" 5844+00.00	New Overpass, remove crossing
Poplar Ave	"WS1" 5885+00.00	New Overpass, remove crossing
Fresno Ave	"WS1" 5919+00.00	New Overpass, remove crossing
Santa Fe Way	"WS1" 6103+00.00	New At-grade crossing (Relocated Lone Star Spur)
Cherry Ave	"WS1" 6108+50.00	New At-grade crossing (Relocated Lone Star Spur)
Burbank Street	"WS1" 6144+00.00	New Overpass, remove crossing
Santa Fe Way	"WS1" 6162+00.00	Road closure, remove crossing (Lone Star Spur)
Kratzmeyer Road	"WS1" 6405+00.00	New Overpass, remove crossing
Reina Road	"WS1" 6444+00.00	Road closure, remove crossing

Section 7.0
Earthwork

7.0 Earthwork

Earthwork designs were completed in accordance with programmatic requirements of TM 2.6.7, no specialty earthwork design was undertaken. Section 5 describes segments of the alignment at-grade or on embankment.

The FB 15% capital cost estimate was primarily based on the prototypical unit price assemblies developed by the PMT with additional assemblies developed by the RC for non-standard or site specific components. The standard unit price assemblies included items for excavation and embankment fill with assumed quantities based on the either the route foot (RF) for linear items such as the HSR alignment or lump sum (LS) for items such as roadway overcrossings.

Table 7.0-1 provides a summary of the earthworks for the Fresno to Bakersfield preferred Alignment using the 15% quantities;

Table 7.0-1
Earthwork Quantities for the Fresno to Bakersfield Preferred Alignment

FB 15% Record Set Fresno to Bakersfield Earthwork Quantities		Excavation (CY)	Embankment (CY)	Balance (CY)
10.01	Track structure: Viaduct	(572,978)	153,377	(419,601)
10.02	Track structure: Major/Movable bridge		22,439	22,439
10.05	Track structure: Cut and Fill (> 4' height/depth)	(105,663)	7,949,875	7,844,212
10.08	Track structure: Retaining walls and systems	(84,906)	1,560,567	1,475,662
10.09	Track new construction: Conventional ballasted (BNSF relocations)	-	760,588	760,588
30.03	Heavy Maintenance Facility (HMF)	(248,500)	-	(248,500)
30.04	Storage or maintenance-of-way building/bases	(80,670)	-	(80,670)
30.05	Yard and yard track	(68,521)	-	(68,521)
40.02	Site utilities, utility relocation	(2,078,900)	-	(2,078,900)
40.05	Site structures including retaining walls, sound walls	(1,356,777)	141,109	(1,215,668)
40.08	Highway/pedestrian overpass/grade separations	(303,021)	2,636,420	2,333,399
		(4,899,935)	**13,224,375**	**8,324,439**

As a separate task, order of magnitude construction quantities were developed in July 2011 to support the DEIR/EIS air quality analysis which was based on the 15% prototypical unit price elements. Quantities were provided for expected earthwork fill/import requirements as well as other construction materials such as ballast, concrete and structural steel. The estimated volume of required fill/import material was 11.3 million cubic yards which is in line with the above table. The earthwork quantities have since been refined for construction packages (CP) 1 and 2-3 Basis of Quantities Estimate reports using volumetric quantities taken from the InRoads model. The volumetric quantities provide a more accurate assessment of the expected fill/import requirements and have yielded a higher volume than shown in the above table. This is a direct result of using a different estimating methodology at the different design stages.

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Section 8.0

Temporary Construction Facilities

8.0 Temporary Construction Facilities

Temporary construction facilities, such as precasting, staging, and laydown areas, anticipated for construction of the HSR were identified as part of the preliminary design of the FB Section and are described in the FB *15% Record Set Constructability Assessment Memorandum* (URS/HMM/Arup, 2013d)). These areas have been incorporated into the project footprint; however, they will not be acquired by the Authority. Ultimately, it is the responsibility of the design-builder (D/B) to determine and acquire the required temporary facilities to construct the HSR based on the D/B's preferred means and methods. Tables 8.0-1 through 8.0-3 list areas identified for use in the environmental analyses and constructability design for the Preferred Alternative.

8.1 Construction Methods

Most of the anticipated construction means and methods would be classified as conventional. Conventional means and methods are those employed by contractors who build roads, bridges, rail trackage, switches, yards, maintenance facilities, and other large infrastructure that require commonly used equipment, readily available labor and tools, and established construction techniques.

For the HSR project, there would be one anticipated construction method that could be classified as unconventional: long spans of elevated track would be built most expeditiously and most cost-effectively using relatively long (approximately 120 feet) and wide (approximately 60 feet) precast concrete sections. These precast sections would be supported on piers spaced approximately 120 feet apart.

8.2 Construction Site Summary

8.2.1 Precast Operations Yards

The precast operations yards would allow mass production of precast concrete sections that would be assembled into elevated viaducts. Approximately 25 miles of viaduct would be precast in sections in these yards, and the sections would then be transported to their sites of erection. The precast operations yards would be strategically located near extended lengths of precast viaduct to minimize transport costs. Rural locations are desirable for precast sites; these facilities would create visual and noise impacts. Five possible precast operations yards have been identified for the preferred alignment and are discussed in the FB 15% Record Set CAM.

8.2.2 Construction Staging Areas

Construction staging areas would house incoming materials; provide areas for material preparation, storage of equipment, maintenance of equipment, operations preparation, and construction offices; and allow good housekeeping throughout the alignment. Haphazard staging of materials and equipment throughout the alignment would not be conducive to the construction process and is not normal practice. Preliminary locations for construction staging areas would be placed at regular intervals along the HSR route. The locations would be low maintenance and minimize public impacts as possible. Each site would regularly and frequently receive materials and equipment; therefore, proximity to arterial roads and direct access to construction side roads is important for reducing the impact on local traffic. Ten possible construction staging areas have been identified for the preferred alignment and are discussed in the FB 15% Record Set CAM.

8.2.3 Construction Laydown Areas

The construction laydown areas would be required for a shorter period than the construction staging areas and would be required to construct the complex structures over existing waterways, highways, and railroads. A total of 12 construction laydown areas identified for the preferred alignment and are discussed in the FB 15% Record Set CAM.

The 12 construction laydown areas applicable to the preferred alignment and discussed in the FB 15% Record Set CAM also would be used to construct the steel truss structures over S Golden State Boulevard and SR 99 in Fresno; over Cole Slough, Dutch John Cut, and Kings River on the H Alignment; over SR 43 in two locations (one on the H Alignment and one on both the K3 and K4 Alignments); and over Eighth Avenue on the C1 Alignment. One of the construction laydown areas would be used for construction of a steel truss structure over Cross Creek on the K4 Alignment. Additional construction laydown areas would be required to construct the steel truss structure over Westside Parkway, Truxtun Avenue, Allen Road, Calloway Drive, and the BNSF Railroad in Bakersfield.

8.2.4 Skewed Crossing Laydown Areas

Four temporary skewed crossing laydown areas identified for the preferred alignment are identified in the FB 15% Record Set CAM. These areas would be required to construct the HSR elevated slab over the BNSF in various locations between Fresno and Bakersfield. Similar to the temporary construction laydown areas for steel truss erection, these sites would need to be acquired on a temporary basis, until the construction of the elevated slabs over the BNSF is complete.

8.2.5 Special Considerations

The precast operations yards, construction staging areas, and construction laydown areas are expected to have 24-hour security.

Precasting and staging areas should be combined where feasible to reduce overall costs and impacts on the environment. Four such combined locations are identified in this DBR. As a general recommendation, both the precast yards and the staging areas should also be combined with the proposed (HMFs or with the maintenance of infrastructure facilities (MOIFs) to be more economical, allow smaller total footprints, and reduce environmental impacts. Where possible, the proposed HMF sites have been considered as precasting and staging options.

The RC has not considered temporary facilities for reconstruction of other transportation facilities as part of the enabling works. It is also conceivable that the D/B team would further pursue the additional staging areas needed resulting from the other improvements.

The FB Section of the HSR is generally divided into the following subsections with alignment prefixes, as shown in Table 8.0-1.

Table 8.0-1
FB Preferred Alignment Subsections

Alignment Prefix	Alignment Subsection Name	Location		County	Corresponding EIR/EIS Alternative
		Begin	End		
F1	Fresno	North of Stanislaus Street	E Lincoln Ave	Fresno	BNSF
M	Monmouth	E Lincoln Ave	E Kamm Ave	Fresno	BNSF
H	Hanford	E Kamm Ave	Iona Ave	Fresno and Kings	BNSF (Hanford East)
K4	Kaweah	Iona Ave	Nevada Ave	Kings	BNSF (Hanford East) (connects to C1 [Corcoran Elevated] or C2 [Corcoran Bypass])
C2	Corcoran Bypass	Nevada Ave	Avenue 128	Kings and Tulare	Corcoran Bypass
P	Pixley	Avenue 128	Avenue 84	Tulare	BNSF
A1	Allensworth Bypass	Avenue 84	Elmo Highway	Tulare and Kern	Allensworth Bypass
L1	Poso Creek	Elmo Highway	Whisler Road	Kern	Allensworth Bypass (connects to BNSF [through Wasco-Shafter])
WS1	Through Wasco-Shafter	Whisler Road	Hageman Road	Kern	BNSF (through Wasco-Shafter)
B3	Bakersfield Urban	Hageman Road	Baker Street	Kern	Bakersfield Hybrid

Table 8.0-2 lists the proposed staging and laydown areas and their access points.

Table 8.0-2
Proposed Staging and Laydown Areas — 15% Design

#	Location	Type	Name	Size (acres)	Construction Access Points
1	Fresno	L[1]	CL1	17	South on S Orange Ave and east onto unidentified road
2	Fresno	L	CL2	20	South on S Parker Drive and by intersection of S Cedar Ave
3	Fresno	P[2] and S[3]	FPC1 and CS2	86	South on S Cedar Ave and east onto Jefferson Ave

#	Location	Type	Name	Size (acres)	Construction Access Points
4	North of Laton	S	CS3	147	SR 41 and Central Valley Highway/SR 43 with access via E Clarkson Ave
5	North of Hanford	L	CL7	16	Along Central Valley Highway/SR 43
6	North of Hanford	L	CL3 and CL4	10 and 33	North on Central Valley Highway/ SR 43 and east on unidentified road
7	North of Hanford	L	CL5	14	North on Central Valley Highway/ SR 43 with access via North Ave and unidentified road
8	Hanford east of Central Valley Highway/SR 43 and Alternative 1 (Kings Tulare Regional Station)	S	CS4-A and CS4-B	86 and 81	North or south on Central Valley Highway/SR 43
9	South of Hanford	S	CS5	124	North or south on Central Valley Highway/SR 43 and east on unidentified road
10	South of Hanford	L	CL8	5	Along Central Valley Highway/SR 43
11	Corcoran	L	CL9	56	North or south on Central Valley Highway/SR 43
12	5 miles southeast of Corcoran	S	CS6-A and CS6-B	168 and 164	North or south on Central Valley Highway/SR 43 with access via Avenue 136 and on Road 32 for CS6-A and Avenue 128 for CS6-B
13	West from Central Valley Highway/SR 43	S	CS7-B	165	North and south from Central Valley Highway/SR 43 and west on Garces Highway
14	One mile south of the city of Wasco	S	CS10	177	North and south from Central Valley Highway/SR 43 to Poso Ave
15	Shafter	P	SPC1-A	67	North or south on Central Valley Highway/SR 43 access via Weidenbach Street and Petrol Road
16	Bakersfield	L	CL11	1.8	Rosedale Highway via Allen Road from south
17	Bakersfield	L	CL12	1.6	East or west from Calloway Drive
18	Bakersfield	P & S	BPC1 and CS9	184	East on SR 58 access via Coffee Road and on Brimhall Road
19	Bakersfield	L	CL14	1	North to Truxtun Ave via G Street
20	Bakersfield	L	CL6	21	North or south on SR 99 access via Truxtun Ave
21	Bakersfield	P	BPC2	24	E California Ave from the north and Potomac Ave from the south

#	Location	Type	Name	Size (acres)	Construction Access Points
22	Bakersfield	P	BPC3	28	North or south of SR 99 to E Truxtun Ave via Rosedale Highway or California Ave

[1] L: Construction Laydown Area
[2] P: Precast Operations Yard
[3] S: Construction Staging Area

Table 8.0-3 lists the proposed skewed crossing laydown areas and their access points.

Table 8.0-3
Proposed Skewed Crossing Laydown Areas — 15% Design

#	Location	Type	Name	Size (acres)	Construction Access Points
1	4½ miles north of Laton	L	SCL1	12	Central Valley Highway/SR 43 to E Conejo Ave
2	4 miles southeast of the city of Corcoran	L	SCL4	31	Central Valley Highway/SR 43 to Avenue 144
3	1 mile south of the city of Wasco	L	SCL6	18	From Central Valley Highway/SR 43
4	Less than 1 mile southeast of the city of Shafter	L	SCL7	29	Central Valley Highway/SR 43 to E Los Angeles Street

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Section 9.0

Stations

9.0 Stations

9.1 Fresno Station- Mariposa Alternative, Alignment F1

The station would be located south of downtown Fresno on parcels bound by Fresno Street on the west, Tulare Street on the east, H Street on the north and G street on the south. The station would be sited between two distinct areas: Fresno downtown's central business district that is home to the City Hall, the County Courthouse, Chukchansi (Baseball) Park, several hospitals, and the majority of downtown Fresno's commercial businesses. Fulton Mall, located roughly one block east of the proposed station, is an area that is becoming the focus of downtown revitalization efforts and will, with new retail investments, be an attractor for the station's passengers. The district known as Chinatown fronts the station to the west and contains a mixture of retail manufacturing uses. The EIR/EIS states that the development of the HSR project involves collaboration with the Fresno and Bakersfield jurisdictions on upcoming updates to local general plans and land use planning processes to establish opportunity for transit-oriented development around the stations.

The proposed station would occupy two sites, one east of and one west of the UPRR right-of-way. The proposed station's parcels east of the UPRR are occupied by a historic Southern Pacific Depot that, in recent years, has been converted to commercial uses. A Greyhound depot and a Fresno County retirement fund building also occupy the eastern parcels. Of the three existing structures, the historic Southern Pacific Depot and its accompanying Pullman shed are planned to remain after the HSR transit uses are constructed. After evaluating several station site alternatives along the UPRR right-of-way in the downtown's general vicinity, the selected site, centered on Mariposa Street, was chosen as the Preferred Alternative. The selection hinged on centering the station on one of Fresno's primary civic streets (which also houses the Courthouse and City Hall) to symbolically link the downtown back to the site's original transit uses. The station's main entry concourse would be prominently viewed from the downtown when looking towards the site. Additionally, the desire expressed by local downtown development interests was to also place the station where it can be readily accessed by pedestrians from the Fulton Mall retail corridor.

The HSR station would consist of six main components: an entry concourse building facing to the downtown; a secondary entry concourse building facing Chinatown; two at-grade train boarding platforms; a pedestrian bridge spanning over the UPRR right-of-way that links the two entry buildings and provides fare gates from which to access the boarding platforms via vertical circulation; a short-term parking lot, kiss-and-ride, bicycle storage, and bus drop-off are located on the parcel adjacent to the eastern entry; and a facility power substation and passenger drop-off located on the parcel adjacent to the west entry. The east and west entry buildings would contain ticket vending facilities, vertical circulation leading to the pedestrian bridge, and support spaces. In addition to these station functions, consistent with requirements of TM 2.2.2 R1, the eastern entry, which is the primary point of station access for the majority of passengers arriving from downtown Fresno, also would accommodate two retail spaces and HSR staff facilities. The station's overall organization would revolve around creating both a prominent civic structure (by scale and volume) and by enabling passengers and Fresno residents to use the building and pedestrian bridge as connectors between both sides of the UPRR right-of-way, which would become relatively impassable once the HSR right-of-way is grade separated and fenced.

9.2 Kings/ Tulare Regional Station East Alternative, Alignment H

The EIR/EIS states that "the KTR East alternative is in King County, in an area adjacent to the City of Hanford Planning Area within the city's Secondary Sphere of Influence. The station area is zoned as light industrial by Kings County and the station would be compatible this zoning;

however, the adjacent land is zoned as agriculture and would be under pressure to develop. The Authority intend to facilitate the annexation of the station area by the City of Hanford for a reasonable extension of municipal services to comply with the Kings County General Plan objective promoting adequate supply of basic services to all new development projects. While some conversion of agricultural lands to transportation-related use would be unavoidable, mitigation in the form of agricultural conservation easement and reduction in the amount of parking station areas would minimize impacts. Land uses surrounding the HSR station are also zoned as commercial and industrial, and development of those lands as a result of the station would be compatible with current land use patterns and policies."

The proposed station's site is on agricultural land north of SR 198, east of 8th Avenue/SR 43, and west of an existing single family residential area fronting on Ponderosa Street. is the station would be accessed from SR 43 via a new station access road and would consist of a new west-facing station building fronting a bus loading plaza and two at-grade parking lots. The elevated outside boarding passenger platforms would be accessed via vertical circulation located at either end of a pedestrian walkway located under the elevated guideway. The station's interiors would be configured to place the public serving functions, inclusive of future concessions, ticket sales office, ticket vending machines, security and restrooms, immediately adjacent to the concourse free area. This free area also would contain seating for the public and waiting passengers. From the Free Concourse, passengers would access trains by passing through fare gates and then, once in the station's paid zone, use the Paid Concourse to reach elevators and escalators that lead to the elevated platforms.

The proposed station's operations functions, consisting of trains control facilities, operations maintenance, mechanical rooms and staff spaces, would be placed behind the passenger-facing functions or under the elevated guideway and out of the public view, and would be readily accessible by maintenance vehicles. Consistent with the EIR/EIS goal of minimizing parking areas, the number of proposed parking spaces provided for day-of-opening operations is consistent with the Authority's ridership projections. The amount of agricultural land dedicated to surface parking could be further reduced with a multi-story parking garage in place of a parking lot.

9.3 Bakersfield Stations - Overview

South of the BNSF right-of-way, the hybrid Bakersfield station, would be sited between Truxtun Avenue and California Avenue to the west of Union Avenue in the vicinity downtown's commercial, government, and convention centers. Immediately north of the BNSF, is the existing Amtrak station (the current terminus of the San Joaquin passenger rail service), parking lots, and single family residences converted to office uses. The station's area is characterized by commercial, industrial, and community facility uses with several vacant parcels generally located south of the BNSF. Bakersfield's city and county government centers are to the northwest and the mix of light industrial and offices are generally located east of the site. New multi-family residential units, Mill Creek Development, were recently constructed west of the site as part of a larger urban revitalization effort. The proposed station would be in front of the elevated HSR guideway and parking needs are met by several parking structures on parcels north, south of the BNSF right-of-way and east of Union Avenue. The proposed stations would have two outside boarding platforms accessed via vertical circulation (stairs, escalators and elevators) from the paid concourse.

9.3.1 Bakersfield Station - Hybrid Alternative, Alignment B3

The station would be a free-standing structure immediately south of and beneath the HSR elevated guideway. The station would be fronted to the south by a public plaza that would provide gathering space along a new extension of 14th Street that extends between S and Union

streets. A bus transit center is located north west of the proposed station under the elevated guideway, and surface parking lots would be located on both sides of the station. Additional structured and surface parking would be distributed around the station on parcels north of the HSR alignment and to the east of Union Street.

The site plan's design intent is to provide flexibility on the sequence with which to develop the parking lot parcels, but to, in all cases, provide convenient passenger access from parking facilities to the station. The station's internal functions would be organized along a central Free Concourse spine from which passengers could access two future concession, ticketing facilities, ticket vending machines, public restrooms, and fare gates providing access to the Paid Concourse area. All the station's support spaces would be distributed along the concourse spine for ease of access from the interior and building's exterior so that they can be readily serviced by supply trucks and trash removal vehicles. North of the BNSF right-of-way, an additional secondary access portal would be provided that connects to vertical circulation leading up to a pedestrian overcrossing that terminates, via vertical circulation at the main station building. The Paid Area would feature passenger seating and vertical circulation (including space for future vertical circulation) connecting to the platforms. Two 1,410-foot-long elevated passenger boarding platforms would flank the guideway on both sides and have, in addition to vertical circulation connecting to the station building, emergency exit stairs that lead to egress walkways terminating at ground level exits. The station's southern façade would be designed to provide a view into the free concourse area that is intended as the station's "great room". This space would be a taller and brighter than surrounding structures so that it could be seen from a distance to provide landmarking for the station site.

Table 9.3-1 provides a summary of configurations for the Fresno, KTR, and Bakersfield stations.

Table 9.3-1
Station Configuration Summary

Name	Location	Configuration	# Of Platforms	Length/ Width	Platform Area Square Footage
Fresno Station-Mariposa Alternative, Alignment F1	Fresno, Fresno County	At-Grade	Two Platforms	1,410 feet long/ roughly 20 feet wide (there are exceptions due to a protection barrier wall that resulted in vertical circulation encroachments)	27,550 (NB), 28,200 (SB)
Kings Tulare Regional Station East Alternative, Alignment H	Hanford, Kings County	Elevated	Two Platforms	1,410 feet long/ roughly 20 feet wide	28,200
Bakersfield Station-Hybrid Alternative, Alignment B3	Bakersfield, Kern County	Elevated	Two Platforms	1,410 feet long/ roughly 20 feet wide	28,200

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Section 10.0

Bridges and Elevated Structures

10.0 Bridges and Elevated Structures

10.1 Introduction

The HSR system will be constructed at-grade, in open trench, in tunnels or on elevated/aerial guideway. Of the 117-mile FB Section, approximately 30% of the HSR mainline would be carried on structure. Rail profiles are typically elevated to clear obstacles such as existing railroads, roadways, and waterways, but elevated structures may also be proposed in floodways or as an effort to reduce impacts on nearby properties. For this report, a viaduct is defined as an HSR aerial structure with more than two spans.

Ten viaduct structures would be on the Preferred Alignment between Fresno and Bakersfield. The viaduct structures would span portions of 5 urban areas, and cross 9 major watercourses, 29 roadways, and 13 existing rail lines. Two of the viaduct structures also would serve as the guideway portions of the Bakersfield and KTR HSR stations. The ten structures are listed in Table 10.1-1

Table 10.1-1
Proposed HSR Viaducts

No.	Alignment	Bridge Name	Length (feet)
1	F1	Fresno	6393
2	H	Conejo	5050
3	H	Kings River	13298
4	H	Hanford	10480
5	K4	Cross Creek	9190
6	C2	SR 43 BNSF	5666
7	A1	Deer Creek	6240
8	WS1	Wasco	11815
9	WS1	Shafter	16195
10	B3	Bakersfield	49968

In addition to elevated structures, this section also describes the basis of design for roadway, below-grade and related supporting structures that are part of the FB Section, including below-grade trench, major culverts, and retaining walls.

10.2 HSR Structures

10.2.1 HSR Structure Types

Bridges and other structures supporting HSR between Fresno and Bakersfield are separated into seven categories: standard viaducts, non-standard viaducts, underpasses, bridges, trench structure, box culverts, and retaining walls.

- Standard viaducts are composed of single-cell prestressed, precast concrete (PS/PC) box girder superstructures with columns at 100 to 130-foot centers.
- Non-standard viaducts:

  - Steel trusses are used for river and major highway crossings where spans exceed 240 feet. Often trusses are combined with standard viaduct approach spans.
  - Balanced cantilever PS/PC structures are used in urban locations where infrastructure requires spans greater than 150 feet. These structures are generally articulated in three span units. The same construction type can also be used for spans between 120 and 150 feet, although more usually in two span configuration.
  - Multi-cell cast-in-place (CIP) box girders are used for wide (typically 120 feet) station structures. These CIP box girder structures, similar to many Caltrans viaducts and overcrossings, are also used for structures to support the varying track spacings that occur with turnouts for platform and maintenance tracks.
  - Elevated slab structures are used to cross BNSF and SR 43 at high skews by creating "above-ground tunnels" with BNSF/SR 43 at-grade and HSR supported on cross beams and a continuous slab above.
- Underpasses (HSR crossing over roadway) consisting of one or two span structures using trusses, single-cell box girders, or PS/PC tub/box girders and are used to carry HSR/BNSF over Tulare Street, Ventura Street, SR 43, SR 46, and Kimberlina, Hageman and Allen roads.

- Bridges (HSR over river) are short structures with standard 120-foot PS/PC box girder spans carrying HSR over Tule River and Poso Creek.

- Trench structures are below-grade, reinforced-concrete U sections comprised of side walls and base slab that allow HSR to pass below the existing E Jensen Bypass in Fresno.

- Box culverts are used for low-flow watercourses and wildlife corridors.

- Retaining walls are used to support approach embankments allowing viaduct lengths to be reduced.

10.2.2 HSR Bridge Geometry

- Bridge lengths were determined primarily by establishing an elevation on the profile to clear major obstacles such as rivers, rail tracks, highways, and roadways. The approach profiles were then optimized to provide minimum clearance for maintenance access under the viaduct, which established the theoretical optimum location of the abutments. Viaducts were extended in urban areas to avoid extensive roadway closures and other existing features. The resulting viaducts range from 5,050 feet in Conejo to 49,968 feet across most of Bakersfield. Table 10.1-1 provides a complete list of the 10 viaducts.

- Bridge widths of standard viaducts are 50 feet, measured from outside of parapet to outside of parapet. Station viaduct structures vary and are up to 120 feet wide. Steel truss widths are up to 49 feet wide but vary with horizontal curvature and span. Outrigger bents at the highly skewed crossings of BNSF and SR 43 vary up to 210 feet.

- Bridge depths vary by structure type. Standard viaduct box girders are 12 feet deep for spans of 100 to 120 feet. The viaduct depth for longer concrete spans is typically 10% of the span length. Elevated slab structures have a nominal concrete beam depth of 6 feet with an additional 6 to 12-inch-deep slab above. The dimension from HSR top of rail (TOR) to low steel of the steel through truss bridges is approximately 6.5 feet.

- Bridge heights above original ground range from approximately 30 feet to 100 feet. Typical viaduct heights range from 30 to 40 feet, reducing towards the abutments. In areas with roadway crossings, the required 16.5-foot clearance above road pavements to bottom of HSR structures results in a minimum of height of 31 feet from original ground to TOR. However, in some dense urban areas such as Bakersfield, the required clearance to major infrastructure such as the elevated Westside Parkway results in extended reaches of viaduct with heights of 100 feet to TOR.

10.2.3 Column / Footing Location

Columns are typically located at 120-foot spacing, as this is the optimum span length based on overall fabrication and construction cost. Variations in span length are added at a minimum of every 20 spans to avoid adverse resonance effects.

Longer spans would be used so that columns and footings avoid major infrastructure. In some locations with highly skewed crossings, the box girder superstructure would be supported by straddle bents at 120-foot longitudinal spacing along the HSR alignment.

Several HSR crossings of BNSF tracks at a high skew would require another structural solution. To clear span BNSF with a conventional span along the HSR alignment would require costly structure lengths and depths, which would force the HSR alignment excessively high above original grade. In these locations, elevated slabs would be used, supported by columns and bents at 30-foot spacing. This design effectively reduces the depth of superstructure necessary to support the track, but does increase the number of columns and footings along the skew crossing.

10.2.4 Foundations

Foundations for HSR structures would be rigid and stiff to meet serviceability and comfort requirements per TM 2.3.2. The standard viaducts would have a 39-foot by 39-foot pile cap supported by four 6.5-foot-diameter drilled shafts. The wider station structures would have a similar foundation type but with a wider footing and more drilled shafts. Elevated slab crossover structures typically use Caltrans type II cast-in drilled hole (CIDH) shafts outside the BNSF right-of-way to minimize the span length of the cross beams supporting the track slab. Non-standard viaducts with truss spans and balanced cantilever PS/PC spans also use pile caps supported on drilled shafts.

10.2.5 Number of Spans

The primary design approach is to use spans in the range of 100 feet to 120 feet so that the standardized PS/PC box girder superstructure may be used for the majority of spans to realize economies of scale. After determining the location of substructures for crossing major obstacles, the number of spans required is based on the length of viaduct necessary to bring the TOR above the obstacle (approximately 30 to 35 feet) and divided by 120. This simple approach was modified as necessary to allow for variations in terrain and locations of natural or infrastructure obstacles.

10.2.6 Transition Structures

To transition from the high vertical stiffness of the viaducts, approach slabs would be incorporated at both ends of the viaduct structure.

10.2.7 Retaining Walls

Retaining walls would be used at all abutments to support the approach fills. It was assumed for design and costing purposes that these walls would have pile-supported foundations. The final determination of foundation type for retaining walls would be made during final design and would be based on more-detailed geotechnical information when available.

Table 10.2-1 lists the HSR structures within the FB section.

Table 10.2-1
Mainline Structure Key Data and Classification

No.	Alignment	Purpose	Location (Beg. Station)	Structural Type	Length	Max. Column Height	No. Of Bents	No. Of Spans	Clearances To Local Facilities		Structure Classification
1	F1	Fresno Street	278+92	RC Slab	84′-0″	16′-6″	1	2	Fresno Street	16′-6″	Primary, Non-Standard
2	F1	Tulare Street	288+61	PC Beams	59′-0″	N/A	0	1	Tulare Street	16′-6″	Primary, Non-Standard
3	F1	Ventura Street	307+66	PC Beams	98′-0″	17′-0″	1	2	Ventura Street	17′-0″	Primary, Non-Standard
4	F1	Jensen Trench	356+65	RC Trench	6760′-0″	N/A	N/A	N/A	E Church Ave	31′-0″	Primary, Non-Standard
									E Jensen Ave	24′-11″	
5	F1	Fresno Viaduct	439+40	Standard Aerial Structure with truss spans	6,393′-0″	~39′	49	49	Golden State Highway	16′-11″	Primary, Standard, Non-Standard and Complex
									BNSF Spur	30′-10″	
									E Hardy Ave	39′-0″	
									E North Ave	38′-7″	
									South Cedar Ave	24′-9″	
									SR99 (Two Locations)	40′-8″ /38′-2″	
									SR 99 Southbound On-Ramp	21′-3″	
									E Muscat Ave	24′-5″	

No.	Alignment	Purpose	Location (Beg. Station)	Structural Type	Length	Max. Column Height	No. Of Bents	No. Of Spans	Clearances To Local Facilities		Structure Classification
6	H	Conejo Viaduct	1105+70	Standard Aerial Structure with Crossover Beam/Slab Structure	5,049'-0"	~25'	32	31	E Conejo Ave BNSF BNSF S Peach Ave	18'-1" 27'-4" 27'-7" 17'-7"	Primary Standard / Non-standard
7	H	Kings River Viaduct	1463+58	Standard Aerial Structure with Steel Trusses	13,297'-6"	~20'	101	102	SR 43 Cole Slough Dutch John Cut 9th Ave Cairo Ave Kings River Levee Road	18'-0" 18'-4" 21'-7" 16'-8" 17'-0" 23'-3" 19'-5"	Primary Standard / Complex
8	H	Hanford Viaduct	1903+57	Standard Aerial Structure	10,480'-0"	~35"	85	86	Grangeville Boulevard Cross Valley Railroad E Lacey Road SR 198	23'-2" 32'-6" 29'-4" 25'-9"	Primary Standard
9	K4	SR 43 Underpass	2240+32	Steel Truss Bridge	574'-0"	~16'-6"	1	2	SR 43	16'-6"	Primary, Complex
10	K4	Cross Creek Viaduct	2446+81	Standard Aerial Structure with Steel Trusses and Beam/Slab Structure	9,190'-0"	~20	73	74	Cross Creek Future SR 43 Realigned SR 43	17'-11" 20'-7" 18'-5"	Primary, Standard /Non-standard/ Complex

No.	Alignment	Purpose	Location (Beg. Station)	Structural Type	Length	Max. Column Height	No. Of Bents	No. Of Spans	Clearances To Local Facilities		Structure Classification
11	C2	Whitley Ave Underpass	2812+76	Steel Half-through Girder	90′-0″	N/A	0	1	Whitley Ave	22′-10″	Primary Non-Standard
12	C2	SR 43/BNSF Viaduct	2989+36	Standard Aerial Structure and Beam/Slab Structure	5,666′-0″	~25′	27	28	Popular Ave SR 43 BNSF	21′-9″ 24′-8″ 27′-3″	Primary Standard / Non-standard
13	A1	Deer Creek Viaduct	4005+25	Standard Aerial Structure	6,240′-0″	~35′	53	54	Deer Creek Stoil Spur	10′-4″ 24′-6″	Primary Standard
14	L1	Poso Creek Bridge	5225+40	Standard Aerial Structure	240′-0″	~20′	1	2	Poso Creek	10′-0″	Primary Standard
15	WS1	SR 46 Underpass	5555+88	Standard Aerial Structure	240′-0″	~25′	1	2	SR 46	16′-7″	Primary Standard
16	WS1	Wasco Viaduct	5564+80	Standard Aerial Structure with Crossover Beam/Slab Structure	11,815′-8″	~30′	90	91	BNSF	24′-0″	Primary Standard / Non-standard
17	WS1	Kimberlina Road Underpass	5715+96	PC/PS Tub Girders	84	N/A	0	1	Kimberlina Road	16′-6″	Primary Non-standard
18	WS1	Shafter Viaduct	5955+30	Standard Aerial Structure with Crossover Beam/Slab Structure and PS Segmental CIP	16,195′-0″	~42′	119	120	N Shafter Ave E Tulare Ave Central Ave Mannel Ave E Lerdo Highway BNSF BNSF Spur S Beech Ave/E LA Ave BNSF Riverside St Proposed Lone Star Spur	18′-3″ 19′-10″ 28′-2″ 29′-3″ 29′-2″ 28′-3″ 29′-1″ 25′-3″ 27′-3″ 27′-10″ 31′-6″	Primary, Standard /Non-standard/ Complex

No.	Alignment	Purpose	Location (Beg. Station)	Structural Type	Length	Max. Column Height	No. Of Bents	No. Of Spans	Clearances To Local Facilities		Structure Classification
									Cherry Ave	29′-10″	
19	B3	Hageman Road UP	6799+53	Standard Aerial Structure	199′-10″	~25′	1	2	Re-aligned Hageman Road	17′-6″	Standard
20	B3	Allen Road UP	6805+28	Steel Truss Bridge	318′-6″	N/A	0	1	Re-aligned Allen Road	19′-6″	Primary Complex

No.	Alignment	Purpose	Location (Beg. Station)	Structural Type	Length	Max. Column Height	No. Of Bents	No. Of Spans	Clearances To Local Facilities		Structure Classification
21	B3	Bakersfield Viaduct	6930+70	Standard Viaduct with Steel Trusses, Beam/Slab Structure and PS Segmental CIP	49,968'-2"	~90'	412	413	Country Breeze Place Calloway Drive/Slikker Drive Thistlewood/Windsong Coffee Road Westside Parkway Westside Parkway Offramp Westside Parkway Westside Parkwa Mohawk St Cross Valley Canal Westside Parkway Truxtun Ave BNSF Gates Cana Empire Drive Canal SR99 Oak Street D Street F Street BNSF H Street H Frontage Chester Ave (Frontage Road) K Street L Street M Street N Street Q Street	28'-8" 41'-0" 56'-5" 64'-0" 27'-2" 40'-10" 56'-0" 58'-5" 54'-11" 70'-0" 17'-1" 71'-2" 67'-5" ~66'-0" 60'-2" ~60'-0" 23'-11" 29'-1" 47'-4" 33'-2" 32'-5" 57'-7" 38'-5" 50'-2" 36'-7" 42'-9" 41'-11" 42'-3" 41'-10" 42'-9"	Primary, Standard /Non-standard/ Complex

No.	Alignment	Purpose	Location (Beg. Station)	Structural Type	Length	Max. Column Height	No. Of Bents	No. Of Spans	Clearances To Local Facilities		Structure Classification
									Kern Island Canal	~40′-0″	
									BNSF Spur	37′-2″	
									Union Ave	47′-11″	
									Sonora Street	29′-2″	
									Tulare Street	29′-0″	
									E Truxtun	25′-7″	
									19th Street	25′-11″	
									Cage Street	25′-7″	
									Miller Street	26′-9″	
									Summer Street	27′-10″	
									SJVR	31′-8″	
									E Truxtun	24′-7″	
									SJVR	35′-1″	
									Ogden Street	39′-7″	
									Chamberlain	43′-8″	
									Mt Vernon	23′-0″	
									Exchange Street	54′-2″	
									Webster Street	57′-10″	
									Steele Ave	59′-6″~	
									East Side Canal	56′-0″	
									Quantico Ave/E Cal Ave	54′-10″	
									Oswell St Frontage Road	60′-0″	
									Oswell St Frontage Road	60′-0″	
									Oswell Street	28′-4″	

10.3 Preliminary Design

10.3.1 Design Criteria

The project team considered the key aspects of the design listed as 15% design scope for Bridges and Elevated Structures in TM 0.1.

More detailed design criteria for the development of the 15% structural design are provided in TMs issued by the Authority as noted in this section. These memoranda present project-specific design criteria. Section 20.0 provides a complete list of reference TMs.

10.3.2 Design Approach

Preliminary structures designs have been carried out at the 15% design stage. The structure types chosen were based on selecting the most appropriate considering ease of construction, clearing an obstacle, repetition of the standard viaduct design where possible to gain economies of scale, and choosing the structural solution that would allow the main HSR vertical alignment to be as low as possible within the landscape commensurate with clearing those obstacles that cannot be grade separated. The structure choice also considered consistency with structures used for the preliminary design of the Merced to Fresno and Bakersfield to Palmdale sections of the HSR project.

The following key factors were considered in the structural design:

- Structural adequacy as specified in TM 2.3.2 and TM 2.10.4
- Seismic performance, as specified in TM 2.10.4
- Interaction between track and structure to check that adequate provision is made for relative and absolute displacements between track and structure in accordance with TM 2.10.10 (with the exception of dynamic analysis using actual high-speed trains and ride comfort checks)
- Constructability and assumed construction methods
- Design economy

10.3.3 Subsidence

The RC made a preliminary evaluation of subsidence along the alignment by comparing the current (2011) ground surface elevation along the alignment taken from the FB 15% Record Set Plan & Profile Sheets to ground surface elevations based on Google Earth (using historic aerials that closely approximate U.S. Geological Survey 1929 elevations). The assessment of subsidence can be found in FB 15% Record Geologic and Seismic Hazard Report submitted in December 2013 (URS/HMM/Arup, 2013i).

10.3.4 Structural Importance Classification

Preliminary design prioritizes "Primary Structures" as defined in TM 2.10.4, Section 2.6.1 as structures directly supporting high-speed trains. In addition, these structures would be part of a critical revenue corridor and are therefore classified as "Important" per Section 2.6.2. The viaduct structures would have variable width (at stations), long spans at obstacle crossings, and unusual framing at straddle bents and elevated slab crossovers and so have a technical classification as complex structures per Section 2.6.3 of TM 2.10.4.

10.4 Drainage Structures

Table 10.4-1 summarizes major drainage structures with overall structure width greater than 20 feet. These structures are generally wildlife crossings, pipe culverts and utility crossings.

Table 10.4-1
Drainage Structure Key Data and Classification

No.	Purpose	Location (Beg. Station)	Structural Type	Length (feet)	Max. Height	Clearances To Track Structure	Structure Classification
1	Central Canal	524+60	Box Culvert	150	10	6 feet min	Primary Non-Standard
2	Viau Canal	567+25	Box Culvert	150	10	6 feet min	Primary Non-Standard
3	Washington Colony No. 15	617+10	Box culvert	100	10	6 feet min	Primary Non-Standard
4	Oleander North Branch No. 17	667+90	Box Culvert (BNSF crossing = 42" pipe)	100	10	6 feet min	Primary Non-Standard
5	Wristen Ditch	736+30	Box Culvert	100	10	6 feet min	Primary Non-Standard
6	Kirby Ditch (Wristen)	739+10	Box Culvert	100	10	6 feet min	Primary Non-Standard
7	Harlan Stevens Ditch	947+90	Box Culvert	100	10	6 feet min	Primary Non-Standard
8	Davis Ditch	970+00	Box Culvert	100	10	6 feet min	Primary Non-Standard
9	Elkhorn Ditch (Realigned)	1013+00	Box Culvert	100	10	6 feet min	Primary Non-Standard
10	Canal Crossing	1451+80	Box Culvert	150	10	6 feet min	Primary Non-Standard
11	Peoples Ditch	1698+40	Box Culvert	150	10	6 feet min	Primary Non-Standard

No.	Purpose	Location (Beg. Station)	Structural Type	Length (feet)	Max. Height	Clearances To Track Structure	Structure Classification
12	East Branch Peoples Ditch	1832+59	Box Culvert	150	-	6 feet minimum	Primary Non-Standard
13	Settlers Canal West Branch	2002+64	Box Culvert	150	-	6 feet minimum	Primary Non-Standard
14	Lakeside Ditch	2005+38	Box Culvert	150	-	6 feet minimum	Primary Non-Standard
15	Canal Crossing	2093+70	Box Culvert	150	10	6 feet minimum	Primary Non-Standard
16	Lakeside Ditch (Eucalyptus Branch)	2122+80	Box Culvert	150	10	6 feet minimum	Primary Non-Standard
17	Melga Canal Crossing	2187+40	Box Culvert	100	15	6 feet minimum	Primary Non-Standard
18	Wreden Ditch	2395+07	Box Culvert	100	10	6 feet minimum	Primary Non-Standard
19	McCann No1 Canal	2448+44	Box Culvert	100	10	6 feet minimum	Primary Non-Standard
20	McCann No 2 Ditch	2529+40	Box Culvert	100	10	6 feet minimum	Primary Non-Standard
21	West Branch Lakeland Canal	2579+00	Box Culvert	120	53	6 feet minimum	Primary Non-Standard
22	Sweet Canal	2732+00	Box Culvert	150	-	6 feet minimum	Primary Non-Standard
23	Beshears Ditch	3118+40	Box Culvert	150	-	6 feet minimum	Primary Non-Standard

No.	Purpose	Location (Beg. Station)	Structural Type	Length (feet)	Max. Height	Clearances To Track Structure	Structure Classification
24	Taylor Canal	3173+00	Box Culvert	150	-	6 feet minimum	Primary Non-Standard
25	Lakeland Canal	3324+00	Box Culvert	150	-	6 feet minimum	Primary Non-Standard
26	Friant-Kern Canal	7015+20	U-Channel	N/A	-	HSR on Viaduct	Secondary 4F Property
27	Unnamed canal	7017+45	Box Culvert	200	-	HSR on Viaduct	Secondary
28	Cross Valley Canal	7084+00	U-Channel	250	-	HSR on Viaduct	Secondary
29	Gates Canal	7124+00	U- Channel	300	-	HSR on Viaduct	Secondary
30	Unnamed Canal	7144+54	U-Channel	150	-	HSR on Viaduct	Secondary
31	Mill Creek	7247+38	U-Channel	200	-	HSR on Viaduct	Secondary
32	Eastside Canal	7394+00	Box Culvert	150	-	HSR on Viaduct	Primary Nonstandard

10.5 Roadway Structures

10.5.1 Grade Separation Structures for Crossroads

Roadways crossing the FB section of HSR are designed either to be closed at the right-of-way boundary or grade separated, passing over or under HSR. Caltrans standard practice for the provision of roadway crossings was used as guidance. Issues of structure type, span arrangement, and ability to withstand earthquake-induced forces are codified in Caltrans' Seismic Design Criteria, Bridge Design Aids, Bridge Design Practice Manual, Memo to Designers, AASHTO LRFD Bridge Design Specifications with Interim Revisions and California Amendments. In addition, TM 2.10.4 requirements are followed for roadway structures.

The overcrossing structures are designed as CIP multi-cellular concrete girder superstructures framing into single or multi-column pier bents with pile caps supported on driven concrete piles. The number of columns in a bent was determined by a combination of span length and width of structure. Pre-cast concrete beams with concrete decks would be used for crossing freight railroads to comply with BNSF restrictions (BNSF-UPRR, 2007) on construction over its tracks.

10.5.2 Bridge Length, Width, Depth, Max Height

Bridge lengths were determined by first establishing bent locations and the interior spans. End spans were then established at 55% to 70% of the adjacent interior span. Bridge lengths and spans were mainly controlled by HSR and BNSF right-of-way. Abutment locations were confirmed by verifying that there would be 2 to 3 feet exposure of the abutment front wall above the intersection with the 1.5H:1V end slope per Caltrans HDM *Memo to Designers and Bridge Design Details*, Section 6, pages 6 through 21.

Bridge width was established by adding 1.5 feet on both sides to the approach roadway cross-section for concrete barriers. The typical sections are defined under the roadway section of this report. On Alignment WS1, one 6-foot sidewalk was added to 7th Standard Road to conform to the existing cross-section. Likewise, at Renfro Road on WS1 two 8-foot-wide sidewalks were added to the 32-foot-wide lane plus shoulder width, and at Rosedale Highway on B3, 10-foot-wide shoulders and one 6-foot-wide sidewalk were included in the typical section.

Bridge depth was determined using Caltrans standard depth-to-span ratios.

Maximum height of bridge above original ground is a function of the HSR profile and the required clearance above TOR.

10.5.3 Column/Footing Locations

Preliminary discussions with the freight railroads established that there would be strong resistance to the placement of columns in railroad right-of-ways. However, there are many instances along the HSR alignment where HSR and freight railroad right-of-way limits would coincide. Consequently, overcrossings would have to span long distances to keep all substructure units out of both right-of-ways. The resulting structure would have to be deeper to accommodate the long spans and the profile would have to be raised to maintain required vertical clearances over the HSR and freight railways. This challenge was discussed by the Program Management Team (PMT) and RC, and where constraints necessitate substructure units to be in portions of HSR right-of-way, placement is subject to the following conditions:

- A minimum clear distance of at least 15 feet must be maintained from face of column to right-of-way fence to allow space for maintenance access and drainage.

- A minimum clear distance of 25 feet must be provided from face of column to center line of the nearest track.
- Footings may extend into these clear zones.
- Columns should be outside the BNSF right-of-way; however, footings may extend into the BNSF right-of-way as long as they are deep enough to allow beneficial use of the right-of way by BNSF.
- In some cases as approved, columns may be inside the BNSF right-of-way provided they are 25 feet clear of track center line (minimum 15 feet with pier protection).

At two overcrossing locations, Fresno Avenue (WS1) and Rosedale Highway (B3), one column is within the BNSF right-of-way. In both cases, all constraints were satisfied.

10.5.4 Foundation Type

Concrete-driven piles are favored by contractors because they are easy to fabricate and transport and can be driven by relatively small equipment. This pile type has been used for all foundations, with the exception of the Hesse Overcrossing in Alignment P where an existing culvert does not allow for a large pile cap at bent 4. Instead, at this location, a Caltrans type II CIDH was used.

10.5.5 Number of Spans

The intent of design is to use spans ranging from 100 to 130 feet. This range allows for flexibility of column placement to avoid infrastructure. Three-span structures were developed for 17 overcrossings with total lengths in the range of 270 to 350 feet. These structures do not have to span BNSF. Four-span structures were developed for 12 overcrossings, the extra span being needed to span BNSF. Five, six, and seven-span structures were designed for locations where both BNSF and SR 43 would be crossed.

10.5.6 Transition Structures

Following the Selection Process for Structure Approach, Pavement Systems on AC Pavement (Caltrans 2014a, Appendix B), overcrossings have not been developed with approach slabs.

10.5.7 Retaining Walls

Retaining walls were specified only where obstructions or property restrictions exist along the sides of the approach embankments. These obstructions and restrictions are identified in Table 10.5-1. Retaining walls would not be used to shorten the overcrossings.

Table 10.5-1
Retaining Wall Obstructions or Restrictions

Street	Alignment	Description of Retaining Wall Obstruction or Restriction
E Manning Ave	M	Manning Ave between S. Cedar Ave and the BNSF tracks is developed with single family residences on the north side and single family residences and a nursing home (Manning's Gardens) on the south side. Retaining walls were used on both sides of Manning Ave to minimize the property impacts and associated costs while preventing whole takes of these properties.

Street	Alignment	Description of Retaining Wall Obstruction or Restriction
E Nebraska Ave	M	E Nebraska Ave was realigned to the south of the existing alignment to avoid impacts to the Winery on the NW quadrant of Nebraska and Chestnut. The winery also has a conveyor belt system that passes under the existing E. Nebraska Ave roadway to move the grape skins to the south side of E Nebraska Ave. A retaining wall was provided to avoid impacts to this conveyor belt system and trucking operation on the south side of E Nebraska Ave.
S Chestnut Ave	M	A retaining wall was used to avoid impacts to the grape handling building on the west side of S. Chestnut Ave.
Fargo Ave	H	Fargo Ave was realigned to the north to minimize impacts to the south. A retaining wall was used on the north side of realigned Fargo Ave to minimize property impacts to three single family residences on the north side of Fargo Ave.
Houston Ave	H	A retaining wall was used to minimize impacts to the Kings County Fire Department Station # 4, located on the north side of Houston Ave.
Kent Ave	K4	A retaining wall was utilized on the north side of Kent Ave to avoid direct impacts to the Lakeside Cemetery.
Nevada Ave	C2	Two retaining walls were used to minimize impacts to the irrigation canal located on the south side of and parallel to Nevada Ave. These two walls are located on the east and west side of the HSR alignment.
Corcoran Bypass	C2	One retaining wall was used to minimize impacts to the electrical sub-station on the north side of Corcoran Highway. Two retaining walls were used to minimize impacts/canal relocation on the south side of Corcoran Hwy.
Whitley Ave.	C2	Retaining walls were used at the abutments to reduce the length of the HSR bridge that crosses over Whitley Ave.
Kimberlina Rd.	WS1	Retaining walls were used at the abutments to reduce the length of the HSR bridge that crosses over Kimberlina Rd.
Merced Ave	WS1	A retaining wall was used to prevent the abutment fill from impacting the HSR alignment.
Poplar Ave.	WS1	A retaining wall was used to prevent the abutment fill from impacting the HSR alignment.
7th Standard Road	WS1	Retaining walls were used to avoid impacts to the access road and residential properties north of 7th Standard west of BNSF and to avoid impacts to the commercial properties east of BNSF.
Rosedale Hwy	B3	Retaining walls were used to avoid impacts to the residential properties and church west of BNSF and side roads that provide access to the neighborhoods east of BNSF.

10.5.8 Changes to Affected Adjacent Facilities

All proposed overcrossings would affect the original roads in order to carry them over the HSR. In most cases, the overcrossing would be on the original horizontal alignment, but some would be on new alignment for highway layout requirements. Staged construction or detours are expected where the original alignment is maintained. New alignments can be built clear of existing

roadway with little or no impact. Local roadways that would be affected are on Alignment M – Chance Avenue at E Manning Avenue; on H at 7½ Avenue and Fargo Avenue; on C2 at 5th Avenue and the Corcoran Bypass; on WS1 at SR 43 ramp and Fresno Avenue; and on WS1 at Santa Fe Way and 7th Standard Road. In addition, BNSF tracks have been realigned on M at E South Avenue, E. Manning Avenue and E. Mountain View Avenue; and on B3 at Rosedale Highway.

10.5.9 Structure Importance Classification

All overcrossings, with the exception of the Westside Parkway/Coffee Road off-ramp, would cross over HSR tracks and are, therefore, classified as primary. The Coffee Road off-ramp is classified as ordinary.

10.5.10 Key Design and Site Constraints

The alignment would pass across a flat, rural landscape. Local roads already avoid major constraints, such as rivers, and need changes only to provide access to adjacent properties. A major constraint has been to conform to the Authority's directives regarding columns within HSR right-of-way, and to BNSF's request that columns stay out of the BNSF right-of-way. In BNSF's case, on WS1 at Fresno Avenue where a bent is located between SR 43 (29 feet, 9 inches to edge of travelled way) and BNSF right-of-way (35 feet, 11 inches to track center line); and on B3 at Rosedale Highway where bent 4 is within the BNSF right-of-way (29 feet, 2 inches clear to relocated BNSF track). An additional constraint is on B3 where the Coffee Road off-ramp would clear span the Friant Canal and parallel maintenance roads.

10.5.11 Existing structures

In Fresno, the HSR tracks would be at grade under SR41 and East Jensen Avenue. These are the only existing structures on the FB section that cross over the proposed HSR. Collapse, failure or falling debris from these existing structures may potentially impact HSR service. TM 2.10.4 Seismic Design Criteria states that these structures require assessment to determine requirements for retrofit or other works. Details of these roadway structures are given in table 10.5-2.

Table 10.5-2
Assessment of Existing Structures

No.	Bridge Name	Bridge Owner	Bridge Number	Inventory Route or Feature	Sufficiency Rating	Recommendation
1	South Fresno Viaduct	Caltrans	42-226 R/L	SR 41	Unknown	Retrofit to meet requirements of TM 2.10.4
2	Jensen Bypass	City of Fresno	520-14E	Jensen Bypass	Unknown	Retrofit to meet requirements of TM 2.10.4

Table 10.5-3 lists proposed roadway crossing structures within the FB Section.

Table 10.5-3
Roadway Structures

No.	Alignment	Roadway Name	Location (Station Of IP)	Structural Type (I.E. Balanced Cantilever)	Length (feet)	No. Of Spans	Horizontal Clearances To Local Facilities	Structure Classification
1	F1	E American Ave	577+34	PS/PC Girder	410	4	28'-1" to HSR 36'-4" to BNSF	Primary
2	M	E Lincoln Ave	633+47	PS/PC Girder	440	4	27'-1" to HSR 33'-2" to BNSF	Primary
3	M	E Adams Ave	686+26	PS/PC Girder	380	4	27'-2" to HSR 33'-6" to BNSF	Primary
4	M	E South Ave	739+08	PS/PC Girder	375	4	27'-11" to HSR 35'-2" to BNSF	Primary
5	M	E Manning Ave	791+99	PS/PC Girder/CIP Box Girder	945	7	28'-0" to HSR 30'-11" Chance Ave 33'-9" to BNSF	Primary
6	M	E Floral Ave	898+65	PS/PC Girder	430	4	28'-5" to HSR 31'-2" to BNSF	Primary
7	M	E Nebraska Ave	955+95	PS/PC Girder	405	4	29'-5" to HSR 36'-11" to BNSF	Primary
8	M	E Mountain View Ave	1007+80	PS/PC Girder	415	4	28'-5" to HSR 39'-5" to BNSF	Primary
9	H	S Clovis Ave	1224+91	CIP Box Girder	300	3	30'-0" to HSR	Primary
10	H	E Elkhorn Ave	1250+51	CIP Box Girder	348	3	31'-0" to HSR	Primary

No.	Alignment	Roadway Name	Location (Station Of IP)	Structural Type (I.E. Balanced Cantilever)	Length (feet)	No. Of Spans	Horizontal Clearances To Local Facilities	Structure Classification
11	H	S Fowler Ave	1289+38	CIP Box Girder	270	3	31′-6″ to HSR	Primary
12	H	E Davis Ave	1351+01	CIP Box Girder	462	3	28′-10″ to HSR	Primary
13	H	Dover Ave	1654+01	CIP Box Girder	305	3	28′-9″ to HSR	Primary
14	H	Excelsior Ave	1706+68	CIP Box Girder	300	3	28′-9″ to HSR	Primary
15	H	Elder Ave	1760+98	CIP Box Girder	385	3	28′-6″ to HSR	Primary
16	H	Flint Ave	1814+88	CIP Box Girder	274	3	″29′-0″ to HSR	Primary
17	H	Fargo Ave	1868+17	CIP Box Girder	315	3	29′-2″ to HSR 41′-10″ to 7½ Ave	Primary
18	H	Hanford Armona Road	2029+29	CIP Box Girder	332	3	29′-0″ to HSR	Primary
19	H	Houston Ave	2083+93	CIP Box Girder	750	7	28′-8″ to HSR	Primary
20	H	Iona Ave	2136+82	CIP Box Girder	335	3	29′-3″ to HSR	Primary
21	K4	Idaho Ave	2120+06	CIP Box Girder	290	3	28′-1″″ to HSR	Primary

No.	Alignment	Roadway Name	Location (Station Of IP)	Structural Type (I.E. Balanced Cantilever)	Length (feet)	No. Of Spans	Horizontal Clearances To Local Facilities	Structure Classification
22	K4	Jackson Ave	2173+32	PS/PC Girder	280	3	28’-0” to HSR	Primary
23	K4	Kent Ave	2289+21	CIP Box Girder	300	3	27’-8” to HSR	Primary
24	K4	Kansas Ave	2343+95	CIP Box Girder	300	3	27’-2” to HSR	Primary
25	C2	Nevada Ave	2622+22	PS/PC Girder/CIP Box Girder	693	6	27'-4" to HSR 30'-11" to BNSF 36'-11" to SR 43	Primary
26	C2	Corcoran	2760+68	CIP Box Girder	355	3	28'-0" to HSR 40'-8" to 5th Ave	Primary
27	P	Avenue 128	3123+80	PS/PC Girder/CIP Box Girder	553	5	27'-8" to HSR 32'-0" to BNSF 35'-5" to SR 43	Primary
28	P	Hesse Ave	3171+13	PS/PC Girder/CIP Box Girder	425	4	27'-5" to HSR 31'-6" to BNSF 33'-8" to SR 43	Primary
29	P	Avenue 112	3232+48	PS/PC Girder/CIP Box Girder	425	4	27'-6" to HSR 31'-6" to BNSF 34'-4" to SR 43	Primary
30	P	Avenue 88	3432+67	PS/PC Girder/CIP Box Girder	530	5	28'-2" to HSR 33'-9" to BNSF 34'-0" to SR 43	Primary

No.	Alignment	Roadway Name	Location (Station Of IP)	Structural Type (I.E. Balanced Cantilever)	Length (feet)	No. Of Spans	Horizontal Clearances To Local Facilities	Structure Classification
31	A1	County Road J22	4118+12	PS/PC Girder	280	3	28'-5" to HSR	Primary
32	A1	Garces Highway	4597+88	PS/PC Girder	280	3	27'-5" to HSR	Primary
33	A1	Pond Road	4782+78	CIP Girder	300	2	28'-8" to HSR 38"-11" to Magnolia Ave	Primary
34	A1	Petersen Road	4848+99	CIP Girder	300	3	29'-9" to HSR	Primary
35	WS1	McCombs Ave	5497+37	PS/PC Girder	490	5	28'-1" to HSR 34'-1" to BNSF 38'-0" to SR 43	Primary
36	WS1	Merced Ave	5835+84	PS/PC Girder/CIP Box Girder	735	5	27'-9" to HSR 28'-2" to BNSF 28'8" to SR 43	Primary
37	WS1	Poplar Ave	5883+33	PS/PC Girder/CIP Box Girder	725	5	27'-5" to HSR 28'-9" to BNSF 32'-0" to SR 43	Primary
38	WS1	Fresno Ave	5921+60	PS/PC Girder/CIP Box Girder	610	5	27'-3" to HSR 36'-0" to BNSF 39'-6" to SR 43	Primary
39	WS1	7th Standard Road	6293+38	PS/PC Girder	555	5	27'-6" to HSR 29'-4" to BNSF 32'-4" to SFW1	Primary
40	WS1	Kratzmeyer Road	6404+97	PS/PC Girder/CIP Box Girder	705	5	27'-4" to HSR 31'-5" to BNSF 31'-5" to SFW1	Primary
41	WS1	Renfro Road	6462+14	PS/PC Girder	495	5	30'-2" to HSR 38'-1" to BNSF 36'-10" to SFW1	Primary

No.	Alignment	Roadway Name	Location (Station Of IP)	Structural Type (I.E. Balanced Cantilever)	Length (feet)	No. Of Spans	Horizontal Clearances To Local Facilities	Structure Classification
42	B3	Rosedale Highway/ SR 58	6880+19	PS/PC Girder/CIP Box Girder	560	4	28'-5" to HSR 25'-10" to BNSF	Primary
43	B3	Westside Parkway Coffee Road	NA	CIP Box Girder	300	3	19'-0" to Maintenance Road	Secondary

Section 11.0
Tunnels

11.0 Tunnels

There are no tunnels between Fresno and Bakersfield.

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Section 12.0

Floodplain Impacts, Hydrology/Hydraulics, and Stormwater Management

12.0 Floodplain Impacts, Hydrology/Hydraulics, and Stormwater Management

12.1 Setting

The area to be traversed by the FB Section has a typical Mediterranean climate. Summers are long, hot, and dry; winters are cool, moist, and relatively short (USACE, 1996). Annual rainfall in the FB section area ranges between 5.5 and 10.5 inches (Western Regional Climate Center, 2010), with the majority of the precipitation occurring between November and April. Runoff events correspond to rainfall and snowmelt (USACE, 1996). Three types of storms produce precipitation in the area: general winter storms, thunderstorms, and tropical cyclones. Flooding is most often caused by high-intensity rainfall during general winter storms, and severe flooding can result from tropical cyclones.

The Central Valley is fairly level, with slopes commonly less than 1%. Natural vegetation is somewhat sparse; however, most of the land area is dedicated to heavy agricultural production. Due to the generally low rainfall in this portion of the Central Valley, agriculture is heavily dependent on a vast network of irrigation canals that crisscross the valley floor. Both irrigation flows and stormwater are conveyed through the irrigation network, as well as by natural streams.

Land uses near the project include a mixture of agricultural, open space, residential, commercial, industrial, railroad, highway, and flood control uses. Soils in the valley tend to be sands and silty sands.

Future climate change in the Central Valley is a possibility. The California Water Plan notes that climate change has been observed in the average Sierra Nevada snowpack decreasing by approximately 10% during the last century, the sea level rising 7 inches along California's coast, peak natural flows increasing over the last 50 years on many of the state's rivers, and many southern California cities experiencing their lowest recorded annual precipitation twice within the past decade (California Department of Water Resources [DWR], 2009).

12.1.1 Regional Features

The FB Section would pass through the following local jurisdictions:

- Fresno County
- City of Fresno
- Kings County
- City of Hanford
- City of Corcoran
- Tulare County
- Kern County
- City of Wasco
- City of Shafter
- City of Bakersfield

County and City of Fresno

The Fresno Metropolitan Flood Control District (FMFCD) provides flood control, urban drainage, and groundwater resource management services within a 400-square-mile watershed located between the Kings River Complex and San Joaquin River. The major FMFCD facilities consist of three reservoirs, five regional flood detention basins, urban basins, and natural and constructed channels (FMFCD, 2009).

Kings County

The County of Kings, State of California, *Improvement Standards* (Kings County, 2003) should be referenced when detailed drainage design is performed in Kings County.

City of Hanford

The City of Hanford has a stormwater system with more than 180 acres of drainage basins. The city also has a new pump station that discharges treated effluent to the Lakeside Ditch Company.

City of Corcoran

The City of Corcoran has a stormwater system primarily consisting of street drainage; however, the system does include lift stations in addition to underground trunk lines for stormwater flows. The system drains to four retention ponds. The system utilizes the Corcoran Irrigation District Canal along Sherman Avenue and Dairy Avenue to carry stormwater flows to the stormwater pond located on Oregon Avenue. The city also utilizes a canal built in 2008 on the city's west side to convey stormwater flows to a new stormwater pump station on Ottawa Avenue.

Tulare County

Drainage system design for the HSR in Tulare County will reference the *Improvement Standards of Tulare County* (Tulare County, 1991).

Kern County

The County of Kern, State of California, *Development Standards* (Kern County, 2010) should be referenced during the detailed design of drainage systems related to the HSR in Kern County.

Cities of Wasco and Shafter

The cities of Wasco and Shafter both have stormwater systems. The objectives pertaining to drainage in Shafter, as outlined in the City of Shafter *General Plan* (City of Shafter, 2005a), should be followed during detailed drainage design. The City of Shafter *Subdivision and Engineering Design Manual* (City of Shafter, 2005b) may also provide guidance on drainage design.

City of Bakersfield

The majority of stormwater runoff in Bakersfield is directed to detention basins, with the remainder directed to the Kern River or various canals. Discharges to the Kern River and canals are required to comply with the Water Quality Control Plan for the Tulare Lake Basin (CRWQCB, 2004).

BNSF Railroad

BNSF tracks are typically 5 feet above grade. Drainage ditches are located on both sides of the track with a minimum depth of 1 foot. The BNSF spans numerous canals, riverines, and cross-drainage flows. Larger waterways are spanned by bridges, or the water is conveyed under the railroad by box culverts.

Irrigation and Agricultural Drainage Canals

The HSR crosses a number of agricultural water supply, storage, conveyance, and groundwater banking infrastructure belonging to numerous local water supply, flood control, sanitation, and irrigation districts.

Levee Systems

The HSR would cross certain natural rivers and channels with levee systems. Three of the levees at the Kings River Complex (Cole Slough/Dutch John Cut/Kings River) are state/federal project levees under the jurisdiction of USACE, the Kings River Conservation District (KRCD), and CVFPB. Construction of the HSR over these levees would require USACE approval. It is intended that the HSR would avoid impacting the USACE jurisdictional levees at the Kings River Complex. The bridge pier and abutment foundations would have 15 feet of horizontal setback from the toe of the levee. The minimum vertical clearance from the top of the levee to the bridge soffit is 18 feet, which is required by KRCD for O&M of the Kings River Complex.

The levees at Cross Creek within the project area are not USACE-jurisdictional levees; however, the levees located west of BNSF along Cross Creek and Tule River, downstream of the project area, are under USACE jurisdiction. These levees were constructed in 1983 during an emergency situation to protect Corcoran from Tulare Lake flooding. These levees do not meet Federal Emergency Management Agency (FEMA) certification criteria and were not utilized in FEMA hydraulic study.

At levees for which no clearance requirements have been received, the assumed minimum soffit elevations are specified in the HH&D report (URS/HMM/Arup, 2013b).

12.2 Floodplain Impacts

The Floodplain Impact Report (URS/HMM/Arup, 2013a):

- Summarizes the regulatory framework pertaining to project floodplain encroachments.
- Summarizes the hydrologic and hydraulic design requirements for bridges and culverts.
- Summarizes preliminary hydrologic and hydraulic data and analyses that support conceptual-level water-crossing designs.
- Identifies the primary water crossings within the reach.
- Identifies additional analyses and permits needed as design progresses.
- Includes conceptual-level water-crossing hydraulic designs.

Table 12.2-1 lists the length (in miles) for each FEMA-designated floodplain crossing associated with each HSR subsection of the preferred alignment. The majority of the floodplains to be crossed by the HSR alignments have shallow flow or ponding 1 to 3 feet deep that spreads out over areas thousands of feet wide. This shallow flooding is primarily due to overflow of stream channels when high flows exceed the capacity of the channels. The HSR project also would cross several stream channels. Floodwater flows within channels involve deeper, faster-flowing water that can potentially erode stream banks and channel bottoms. Natural and beneficial uses of floodplain areas include, but are not limited to, natural storage of floodwaters, river/floodplain interaction, habitat, and open space.

The proposed HSR alignments would be designed to accommodate the passage of flood flows. Adequate culverts and bridge openings for cross drainage would be placed at appropriate locations, matching where embankments already exist along adjacent projects. Table 12.2-2 summarizes the expected types of floodplain crossings that would occur for each floodplain. Some alignments cross the same floodplain multiple ways. Impacts on natural and beneficial floodplain values as a result of the construction of the HSR are expected to be minimal.

Table 12.2-1
Length (miles) of FEMA Floodplains Crossed by HSR Alignments

Alignment		Location / FEMA Designated Special Flood Hazard Zone									
	Church Avenue/ Zone AH	N. Central Canal/ Zone A	Central Canal/ Zone AE	Kings River Complex/ Zone A	Cross Creek/ Zones AE & A	Tule River/ Zone A	Deer Creek/ Zones A & AO	Poso Creek/ Zone A	Shafter/ Zones AH & AO	Weidenbach Street/ Zone A	Kern River/ Zone AE
F1	0.62	0.02	0.03	—	—	—	—	—	—	—	—
H	—	—	—	2.59	—	—	—	—	—	—	—
K4	—	—	—	—	3.28	—	—	—	—	—	—
C2	—	—	—	—	0.79	3.48	—	—	—	—	—
P	—	—	—	—	—	—	0.66	—	—	—	—
A1	—	—	—	—	—	—	3.18	0.2	—	—	—
L1	—	—	—	—	—	—	—	2.02	—	—	—
WS1	—	—	—	—	—	—	—	—	0.31	1.83	—
B3	—	—	—	—	—	—	—	—	—	—	1.61

Table 12.2-2
Proposed Types of Floodplain Crossings

Floodplain	On Embankment	In Cut or Trench	On Viaduct or Structure
Church Avenue	—	F1	—
North Central Canal	—	—	F1
Central Canal	—	—	F1
Kings River Complex	H	—	H
Cross Creek	K4, C2	—	K4
Tule River	C2	—	C2
Deer Creek	P, A1	—	P, A1
Poso Creek	A1, L1	—	L1
Shafter	—	—	WS1
Weidenbach Street	WS1	—	—
Kern River	—	—	B3

FEMA-identified flood hazard areas are used to determine locations where the land crossed by the HSR might be susceptible to flooding and, therefore, warrant raising the HSR above the flood level. Flood insurance studies conducted on behalf of the counties of Fresno, Kings, and Tulare, summarizing flood problems and feedback from irrigation districts and cities have also identified local areas prone to flooding. Flooding due to dam failure was not one of the factors considered relevant for the study of floodplain impacts.

Although an extensive flood control system has been constructed in the region, large portions of the Central Valley are considered to be flood hazard areas. This threat is mainly from riverine flooding and ponding on the flat valley floor. The San Joaquin Valley and Tulare Lake Basin are relatively flat with broad, shallow floodplains that are either uncontained or uncontained at higher flows due to levee overtopping. Therefore, the water surface elevation (WSE) is not expected to increase greatly as the flow rate increases. For example, the difference between the 100- and 200-year storms may be less than 1 foot in elevation. In the vicinity of the proposed alignments, a significant factor contributing to the size of the floodplains is the existing BNSF railway embankment, which acts as an impediment to water moving from east to west toward the Tulare Lake Basin.

A variety of structures provide flood control in the study area. Some of these flood control structures were constructed as part of state/federal flood control projects funded by either the State of California or the federal government. For projects funded by the federal government, the state assumed responsibility for O&M after completion and exempted the federal government from any related claims for damages. Statewide, project flood control facilities consist of 1,569 miles of levees, hundreds of miles of improved flood channels, and 56 major flood control works (DWR, 2010). CVFPB has responsibility for O&M of project flood control facilities throughout the Central Valley. In many cases, CVFPB has turned over O&M to local flood and levee districts under its jurisdiction. However, one exception to this is at the Kings River Complex. KRCD has been contracted directly by USACE to perform O&M activities on the portion of the Kings River between the City of Kingsburg and SR 41 (South Fork of the Kings River) or SR 145 (North Fork).

DWR is assisting in the planning and coordination of major implementation actions of the 2012 Central Valley Flood Protection Plan through the Central Valley Flood Management Planning Program, which will identify improvements to the project flood control facilities and 1,200 miles of designated floodways—collectively called the State Plan for Flood Control. The program will also identify flood hazard areas in urban or urbanizing areas of the Central Valley and recommend levees or other means for protecting these areas. The California Public Resources Code 5096.805 identifies an urban area as "any contiguous area in which more than 10,000 residents are protected by project levees." The mandate is to provide flood protection by the year 2025 for urban and urbanizing areas from a 200-year flood event. DWR is defining and mapping 200-year flood hazard areas.

Non-project flood control facilities include levees and related facilities constructed by local agencies along rivers, creeks, and streams in the Central Valley. Many of these facilities are operated and maintained similar to project facilities, and some connect to project facilities. By definition, they are not part of the State Plan for Flood Control; however, the non-project levees affect the performance of the State Plan for Flood Control as part of the flood protection system.

12.3 Hydrology/Hydraulics

The Hydrology, Hydraulics, and Drainage Report (URS/HMM/Arup, 2013b) describes hydrologic and hydraulic analysis methods and preliminary drainage design concepts for natural channels, sloughs, and manmade drainage features that would be crossed by the HSR project.

The following categories were reviewed as part of the hydraulic basis of design:

- Design flow
- Flood capacity
- Protection of flood control structures
- Channel stability and scour control
- Access
- Seasonal construction restrictions
- Other studies

12.3.1 Design Flow

Natural drainage in Central California along the HSR alignment generally flows in a westerly direction from the mountains and foothills to the east through the low-gradient Central Valley. Flooding tends to occur against canal berms, levees, and road embankments, unless there is a provision for cross-drainage flow passage. According to FEMA floodplain maps, when stream channels exceed their banks under 100-year flow conditions, flooding from 1 to 3 feet may extend over large areas of the Central Valley.

Manmade embankments, such as the BNSF, can restrict the natural flow of floodwater even where bridges and culverts have been provided. In the case of the HSR and associated road embankments, adequately designed bridge openings, culverts, or siphons would be necessary to provide cross-drainage, thus ensuring no blockage or diversion of shallow flood flows.

HSR crossings of waterways will be configured to accommodate a freeboard above the design-flow WSE to allow passage of debris that might otherwise block the passageway and to allow for potential waves caused by surges in the water flow. Specific hydraulic criteria depend on the crossing classification and the regulatory criteria. When more than one set of regulatory criteria applies, the most stringent set would be used for the design.

The categories of flow rates that require consideration include:

- State/federal flood control project authorized flow rate
- FEMA 100-year base flood
- 200-year base flood (Effective 2015, DWR will require municipal floodplain ordinances for urban and urbanizing areas to manage the 200-year base flood.)
- Canal design flows
- Best new hydrology
- Minimum design flood
- Flood capacity

12.3.2 State/Federal Flood Control Project Authorized Flow Rate

The required freeboard relative to the lowest member of a bridge is normally 3 feet but can be reduced to 2 feet at minor creeks where debris issues are minimal. Where the bridge crosses a levee, 4 feet of freeboard is normally required. USACE mandates the clearance above state/federal flood control project levees. USACE requires that flow restrictions from the encroachment of piers, culverts, abutments, or other project elements cause no more than a 0.1 foot rise in the project floodwater-surface elevation at any location. Exceptions to these requirements are subject to Section 408 permits.

12.3.3 Floodplain Boundaries

CVFPB, USACE, FEMA, DWR, and other parties have mapped approximate floodplain boundaries; but often these maps do not provide depth or base flood elevations. In the case of regulated streams without depth or base flood elevations, CVFPB advised that the project WSE should be assumed to be at or below the top of the channel (no floodplain flow). Subsequent direction from CVFPB has indicated that original hydrology and hydraulic modeling may be required.

12.3.4 Management Agency Floodway

No rise in base flood elevation will be permitted if the HSR infrastructure encroaches within the floodway itself. This restriction is to prevent the accumulated effect of multiple projects from eventually resulting in more than a 1-foot rise in the base flood.

12.3.5 200-Year Floodplain

Beginning in 2015, DWR will require municipal floodplain ordinances for urban and urbanizing areas to manage the 200-year flood.

12.3.6 Irrigation Canals

Irrigation districts typically require 2 feet of freeboard relative to the soffits of bridges and box culverts. If a canal is also regulated for flood control by CVFPB, then a minimum of 2 feet of freeboard will be required for the crossings with limited debris potential. If the crossing design causes a rise in the canal WSE, a minimum of 1 foot of freeboard to the top of the bank should be provided along the length of the canal. In addition, for a bridge crossing, a minimum of 8 feet of vertical clearance is required from the bottom of the canal to allow for maintenance access under the bridges. The section of canal that passes under the HSR right-of-way would be concrete-lined to minimize erosion and subsequent canal maintenance.

Maintenance access will be required for irrigation/drainage canals and ditches. For the culvert crossings at the HSR alignments, the existing canal or ditch access roads may be blocked by the HSR right-of-way. Under these situations, it will be necessary to design the culverts with extra

length extending beyond the HSR right-of-way, to allow a maintenance vehicle to turn around at each side of the HSR embankment.

12.4 Stormwater Management

The Stormwater Quality Management Report (URS/HMM/Arup, 2013c) provides a high-level plan for managing stormwater between Fresno and Bakersfield at the preliminary design level. The emphasis of the report is management of stormwater associated with the HSR; however, it also addresses stormwater considerations for roads and highways that may be altered or relocated to accommodate the HSR.

The objectives of the drainage design include:

- Maintaining existing drainage flow patterns.
- Dispersing on-site runoff to encourage local infiltration.
- Incorporating existing drainage systems.
- Improving existing drainage capacity if the HSR exacerbates existing drainage problems or flooding at a location where the existing system is known to be undersized.
- Treating runoff from pollution-generating impervious surfaces to the maximum extent practicable to meet water quality objectives and water quality standards set forth by the California Regional Water Quality Control Board (RWQCB) before discharging to receiving waters.

Stormwater runoff from station parking lots, maintenance facilities, and railroad rights-of-way would be directed as sheet flow into the adjacent drainage systems or directed through swales to infiltration basins. The basins would be designed as a water quality control measure. No runoff from the project is to be discharged directly into any surface water bodies, irrigation canals, private property, or county roads. Runoff from bridges, overpasses, underpasses, and aerial structures would be collected and discharged within the project area or adjacent storm drainage systems.

12.4.1 Drainage Conditions

At-grade track segments – Rainfall would flow into drainage ditches within the HSR right-of-way. Emphasis will be placed upon on-site retention of runoff. The on-site ditches and retention basins will be designed to accommodate the 25-year design storm event for rural areas and the 50-year design storm event for urban areas. For highly developed urban areas, areas with poorly draining soils, and known drainage problem areas, conventional stormwater ditches leading to established discharge locations likely would be required.

Embankment segments supported by retaining walls – Trackbed drainage would be collected and conveyed in a pipe system. Storm drains may also be incorporated behind the top of the retaining walls to accommodate peak events. All concentrated flow would be addressed in a non-eroding manner.

Below-grade or trench segments – There would be drainage systems to collect stormwater and direct it to a pump station. Stormwater would be pumped to a retention basin outside the trench and released into a drainage facility where available.

Elevated track segments – Where the guideway crosses an unpaved rural landscape, the runoff would be collected from the guideway and conveyed in pipes down the sides of the pier columns to infiltration swales. Where the guideway crosses developed urban areas, the runoff would again be conveyed in pipes down the sides of the piers, but usually would be discharged into the local stormwater drainage system. Should there be insufficient capacity to handle the runoff from the HSR, additional disposal measures would have to be developed, such as on-site detention basins.

Future KTR Station – When developed, the passenger station would consist of significant impermeable surfaces in the form of roofs, platforms, ramps, stairs, buildings, parking areas, and other hard structures. Some or all of these structures may be classified as pollutant-generating surfaces, requiring water treatment and detention prior to release to existing stormwater systems. As design progresses, the stormwater system may include such features as inlets, grated catch basins, storm drains, flow splitters, detention/infiltration basins, energy dissipaters, infiltration trenches, filter strips, biofiltration swales, and permeable pavement.

Modified roadway intersections – Roadways would be grade-separated wherever they intersect the HSR at-grade. Runoff from new roadway pavements would require stormwater treatment and, in some cases, flow attenuation to meet current stormwater management requirements. Discharges from Caltrans's right-of-way will be subject to Caltrans National Pollutant Discharge Elimination requirements.

Subject to clarification of soil conditions, the stormwater may be infiltrated on site, resulting in reduced requirements for water quality treatment. If on-site infiltration cannot be achieved, stormwater detention would have to be provided along with pumping and possibly treatment.

12.4.2 Detention Devices

A detention basin is a permanent feature that temporarily detains stormwater runoff, such that sediment and particulates are able to settle before the runoff is discharged. A portion of the detained water is also lost due to infiltration (if the basin is unlined) and evaporation. Detention basins will be designed to remove litter, settleable solids (debris), total suspended solids, and pollutants. Detention basins are primarily suited for sites where the water quality volume is at least 0.1 acre-foot, where the seasonal high groundwater is below the bottom of the basin, and where an elevation difference is available so that water stored in the basin does not cause objectionable backwater conditions in the storm drain systems. Detention basins should be designed to drain within 72 hours. Media filters remove particulates from runoff by sedimentation and filtration, and are effective for removing dissolved metals and litter.

12.5 Section 408 Determination

USACE will require a Section 408 Determination for the FB Section crossing of the Kings River Complex, which includes Cole Slough, Dutch John Cut, and the Kings River Old Channel. The 408 Determination Report for Kings River Complex was prepared for USACE review in October 2013 (URS/HMM/Arup, 2013d). This report included draft 15% design-level drawings of the HSR Alignment H Kings River Viaduct dated October 11, 2013, and presented the hydraulic impacts caused by the proposed encroachment at regulatory flow rates. In addition, the report provides information about O&M considerations.

During the USACE review coordination process, the viaduct bent within the Kings River Old Channel was shifted 30 feet toward the south bank to allow the rise in WSE not to exceed 0.1-foot at the crossing, under either the USACE O&M flow or the FEMA 100-year peak flow. The 408 Determination memo of October 2013 was not updated to include this revision. The information was communicated to USACE by the Authority's permitting team.

A written response from the USACE Sacramento District to the Section 408 determination request was received on January 17, 2014. This response letter stated that the Sacramento District preliminarily recommends Section 408 approval for the crossing of the Kings River Complex based on the information provided. The proposed crossing would require a CVFPB encroachment permit. Sacramento District's final recommendation will be made as part of the review of the CVFPB encroachment permit application. The response letter also stated that if the design changes, this recommendation is no longer valid and may require approval from USACE Headquarters.

Section 13.0

Utilities

13.0 Utilities

13.1 Utility Impact Report

The FB 15% Record Set Utility Impact Report submitted in December 2013 (URS/HMM/Arup, 2013e) provides preliminary information about the high- and low-risk utilities that would be affected by the construction of the HSR over the entire 117-mile segment.

The footprint of the HSR used to assess impacts on utilities in the Utility Impact Report consisted of the track corridor, stations, HSR facilities, and associated roadway relocations. The footprint for the HSR trackway was defined as between 60 and 340 feet wide for the various aerial, trench, retained fill and embankment (at-grade) sections. The footprints for the roadways were defined by the outer limit of the cut-and-fill slopes for all proposed improvements, including roadside ditches for the grade separations.

13.2 Methodology

As part of the FB 15% design, information regarding existing utilities was obtained from the various utility agencies and focused on the identification of high-risk utilities.

High-risk utilities are defined by TM 2.7.4, as facilities carrying the following materials:

- Petroleum products (jet fuel, crude oil, gas oil, gasoline, etc.)
- Oxygen
- Chlorine
- Toxic or flammable gases or liquids.
- Natural gas pipelines of any size.
- Underground electric supply lines (300 volts and larger that do not have concentric grounds or other effectively grounded metal shields or sheaths).
- Water in pressured pipeline.
- Other utilities that could disrupt the operation of HSR.

The classification as "High Risk" is not dependent on whether or not the utility is encased.

"Low-Risk Utilities" are defined by TM 2.7.4 as all utilities or facilities not categorized as "High-Risk Utilities."

13.2.1 Data Collection

The HSR design team solicited utility information from numerous cities, counties, public and private utility companies, irrigation, water, flood control and sanitation districts. Appendix A of the Utility Impact Report includes a list of the agencies contacted. Letters, phone calls, and email correspondence were made to request information, and follow-up calls were placed when initial attempts to obtain utility data proved unsuccessful (see Appendix C of the Utility Impact Report). Seventeen of the 59 contacted agencies had no utilities within the proposed HSR right-of-way. All other utility data received were collated using the following four methods:

- GIS
- Utility Drawings
- Field Verification
- Public Aerial and Ground-Level Imagery

The manner in which the information was solicited during the 15% design phase resulted in the information meeting the Quality Level D criterion as defined in TM 2.7.4. Efforts were made to gather a comprehensive database of utility information; however, comprehensiveness and accuracy of the information are entirely dependent upon agency cooperation and the quality of its information.

13.2.2 High-Risk Utilities

Appendix B of the Utility Impact Report includes a list of known high-risk utilities for all subsection alignments considered. Table 13.2-1 provides an abridged version of that list depicting only subsections contained in the Preferred Alternative. The list includes the following utility types:

- Overhead HV transmission mains
- Buried longitudinal utilities within freight rail rights-of-way where the freight rail trackage requires relocation to accommodate the HSR rights-of-way.
- Gas mains
- Petroleum lines

13.3 Construction Considerations

13.3.1 HV Transmission Lines

The most significant utility concern is the development of a scheduling and contracting arrangement that allows the relocation of HV transmission mains without impeding the construction of the HSR track bed and ancillary local roadway overpasses. Approximately 4.5 miles of the Pacific Gas and Electric Company (PG&E) 115-kilovolt (kV) Kingsburg–Corcoran transmission line between approximate Stations 1745+00 to 1981+00 on the H alignment would require horizontal and vertical relocation to accommodate the HSR right-of-way.

An analysis for the potential of HSR OCS fouling, following CPUC General Order 95, Rule 22.1-A, was conducted for the section of the Kingsburg-Corcoran HV line between Excelsior Road and Rt. 198 where the HV line closely parallels the HSR alignment. PG&E has reported the existing HV line is deficient in some areas along this interval with respect to current CPUC vertical clearance requirements. An existing tower height of 80 feet (provided by PG&E) was used for the tower toppling analysis. The analysis found that sixteen existing towers could potentially foul the HSR OCS system due to a failure mode as described in Rule 22.1-A. An additional four towers in this interval are located within 10 feet or less of the proposed HSR right-of-way in the vicinity of the Hanford station and two more towers are situated in the Hanford station parking lot, immediately west of the front façade of the station. Based upon the above evaluation, it was determined that relocation of 4.5 miles of the existing PG&E HV line was appropriate.

An alternatives analysis for the HV transmission line relocation determined that offsetting the existing facility sufficiently to the east side of the HSR alignment to achieve conformance with the tower toppling criteria would result in fewer secondary HSR project impacts, including to dairy farms, between Excelsior Road and Rt. 198, than would relocation to the west side of the HSR ROW.

13.3.2 Fiber-Optic Transmission Lines

Relocation of fiber-optic communication lines located within, or directly adjacent to, BNSF freight rail rights-of-way also presents scheduling challenges. The fiber-optic relocation work must be coordinated with both the relocation of the BNSF freight rail trackage and the HSR track bed construction. Fiber-optic communication line relocation is required between approximate Stations 709+50 to 872+02 and Stations 934+78 to 1062+13 on the M alignment.

13.3.3 Natural Gas Lines

Where construction activity affects existing underground natural gas lines, relocation of those lines may be necessary at some locations, including those related to roadway grade separations, HSR tracks, or placement of HSR viaduct columns. The owners of these gas lines within the FB Section are PG&E and Sempra Energy Company.

13.3.4 Water lines

Construction of a roadway grade separation, HSR tracks, or an HSR viaduct column may affect the existing underground water lines. Known impacted pipe diameters vary from 6 inches to 27 inches. The majority of impacts occur within the urban areas of the FB Section.

13.3.5 Abandoned Facilities

Abandoned petroleum pipelines exist within and adjacent to the HSR rights-of-way between Stations 3015+00 to 3277+00 and 3356+00 to 3437+00 on the C2 and P alignments, respectively. Information received from Chevron indicates that two pipelines, identified as the Old Valley Pipeline and the Tidewater Associated Oil Company pipeline, existed within the project area. Operations ceased in the 1940s and 1970s, respectively, for these two pipelines. Accordingly, relocation of these underground facilities is not required. Chevron has advised that the operating companies (and their successors) hold no interest in the abandoned pipelines nor in their rights-of-way. The pipelines were reportedly installed at depths ranging between 18 inches and 10 feet below grade. The method of decommissioning varied from pipe removal to abandonment in place. Chevron also reported that historical releases of petroleum from the pipelines have been observed in the past. Furthermore, the pipelines typically were encased in protective coatings composed of coal tar and asbestos-containing felt material. Accordingly, the contract documents for construction of the track bed for the HSR should make provisions for removal of the pipeline where it exists within the track bed footprint and for proper handling and disposal of the pipelines and contaminated soils that may be encountered.

13.3.6 Oil Wells

The southern portion of the Central Valley contains the most productive oil and gas fields in California. Included in this region is the area between the cities of Wasco and Shafter. The area northeast of Bakersfield also supports active oil fields.

The FB Regional Consultant memorandum, *FB Oil Well/HSR Conflicts — Basis of October 2013 Data Table and Mapbook Update* (URS/HMM/Arup, 2013h), outlines the oil well/HSR conflicts along all FB section alternatives. Based on data available from the California Department of Oil, Gas, and Geothermal Resources (as of August 2013), the Through Wasco-Shafter WS1 Alternative has no active oil and gas wells, two new oil and gas wells, and one plugged oil and gas well within the prescribed 200-foot safety buffer zone. The Bakersfield Urban B3 Alternative has three active oil and gas wells, no new oil and gas wells, and three plugged oil and gas wells within the 200-foot safety buffer zone.

HSR impacts on oil wells, ancillary equipment (e.g. hydraulic fracturing chemical tanks), and associated transmission piping may have significant risks and costs, including relocation. The location and extent of collection piping is unknown. Approximate abandonment and relocation costs for oil and gas wells and water disposal wells in the project area are presented in a draft technical report, *Draft Assessment of Oil, Gas and Disposal Well Relocation Costs, Wasco-Shafter Alignment Alternatives, Fresno to Bakersfield Section* (Cook, 2013). Vintage Production, a subsidiary of Occidental Petroleum, also has estimated costs to mitigate impacts on oil and gas wells and production systems under their control in the North Shafter and Rose oil fields in the vicinity of the proposed Wasco-Shafter Bypass and Through Wasco-Shafter alignments.

13.4 Other Construction Impacts

Special utility considerations include the potentially significant cost and schedule risk that may be associated with the relocation of utilities impacted by depressed rail and road construction. In the F1 sub-alignment, depressed track in the vicinity of Jensen Avenue in the City of Fresno between the approximate Stations 356+65 to 424+25 required special consideration of the numerous sewer, water, and storm drain facilities that run below the alignment and would be affected. The depressed HSR section varies in depth from 0 feet to approximately 6 feet. Table 13.4-1 provides a list of utilities within the preferred alignments that fall under this category due to the depressed HSR alignment.

Depressed roadways proposed within the FB Section include the Fresno Street underpass (F1), the Tulare Street underpass (F1), the SR 43 underpass (K4), the SR 137 underpass (C2), the Kimberlina Avenue underpass (WS1), and the Santa Fe Way underpass (B3). Some utilities, particularly where underpasses occur in urban areas, would require relocation. Table 13.4-2 provides a list of utilities within the preferred alignments that fall under this category due to roadway underpass.

There are no HSR design variances based on utility criteria.

Table 13.4-1
F-B Preferred Alternative High-Risk Utility Information Log

No.	HSR Alignment	Station	Cross Road(s)	Owner	Facility Type	Size	Units	Length (feet)	Disposition
1	F1	258+62 to 270+64	Stanislaus Street and Tuolumne Street	Kinder Morgan Inc.	Petroleum	8	inch	1,209	Relocated
2	F1	291+20	Tulare Street Kern Street	PG&E	Natural Gas	8	inch	235	Relocated
3	F1	340+43	S Cherry Ave	PG&E	Natural Gas	8	inch	178	Relocated
4	F1	356+23	E Florence Ave	PG&E	Transmission Lines	115	kV	162	Relocated
5	F1	379+38	S East Ave	PG&E	Transmission Lines	115	kV	204	Relocated
6	F1	380+09	S East Ave	PG&E	Transmission Lines	69	kV	204	Relocated
7	F1	446+09	S Golden State Blvd	PG&E	Natural Gas	8	inch	90	Relocated
8	F1	452+01	S Golden State Blvd	Kinder Morgan Inc.	Petroleum	8	inch	90	Relocated

No.	HSR Alignment	Station	Cross Road(s)	Owner	Facility Type	Size	Units	Length (feet)	Disposition
9	F1	516+11 to 522+86	E Central Ave	PG&E	Natural Gas	8	inch	685	Relocated
10	F1	524+38	E Central Ave	Unknown	Petroleum	-	inch	130	Relocated
11	M	686+10	E Adams Ave	Unknown	Natural Gas	-	inch	146	Relocated
12	M	790+17	E Manning Ave	PG&E	Natural Gas	6	inch	136	Relocated
13	M	831+42	-	PG&E	Transmission Lines	230	kV	924	Relocated
14	M	832+19	-	PG&E	Transmission Lines	115	kV	137	Relocated
15	M	898+75	E Floral Ave	Sempra Energy Company	Natural Gas	8	inch	157	Relocated
16	M	909+32	-	Sempra Energy Company	Natural Gas	8	inch	164	Relocated
17	M	909+33	-	Sempra Energy Company	Natural Gas	9	inch	165	Relocated
18	M	952+65	E Nebraska Ave	Sempra Energy Company	Natural Gas	3	inch	141	Relocated
19	H	1114+51	-	Sempra Energy Company	Natural Gas	6	inch	87	Relocated
20	H	1119+33	E Conejo Ave	Sempra Energy Company	Natural Gas	6	inch	87	Relocated
21	H	1119+80	E Conejo Ave	Sempra Energy Company	Natural Gas	10	inch	87	Relocated
22	H	1465+81	SR 43	PG&E	Transmission Lines	70	kV	104	Relocated
23	H	1749+40 to 1764+97	Elder Ave	PG&E	Transmission Lines	115	kV	1,560	Relocated

No.	HSR Alignment	Station	Cross Road(s)	Owner	Facility Type	Size	Units	Length (feet)	Disposition
24	H	1949+95 to 1957+32	-	PG&E	Transmission Lines	115	kV	736	Relocated
25	H	1950+06	-	Sempra Energy Company	Natural Gas	12	inch	172	Relocated
26	H	1959+58 to 1960+54	Ponderosa Road	Sempra Energy Company	Natural Gas	2	inch	112	Relocated
27	H	1976+24	Lacey Blvd	Sempra Energy Company	Natural Gas	6	inch	176	Relocated
28	H	1978+17	7th Road	Sempra Energy Company	Natural Gas	12	inch	172	Relocated
29	H	2029+37	Hanford Armona Road	Sempra Energy Company	Natural Gas	2	inch	122	Relocated
30	H	2089+35	Houston Ave	unknown	Natural Gas	2	inch	120	Relocated
31	K4	2100+41 to 2115+00	Idaho Ave	PG&E	Transmission Lines	115	kV	1,472	Relocated
32	K4	2119+83	Idaho Ave	Sempra Energy Company	Natural Gas	2	inch	128	Relocated
33	K4	2132+14 to 2145+62	-	PG&E	Transmission Lines	115	kV	1,354	Relocated
34	K4	2173+54	Jackson Ave	Sempra Energy Company	Natural Gas	3	inch	133	Relocated
35	K4	2173+58	Jackson Ave	PG&E	Transmission Lines	115	kV	133	Relocated
36	C1	2749+79	Orange Ave	Sempra Energy Company	Natural Gas	6	inch	167	Relocated
37	C1	2751+25	Orange Ave	PG&E	Transmission Lines	70	kV	92	Relocated

No.	HSR Alignment	Station	Cross Road(s)	Owner	Facility Type	Size	Units	Length (feet)	Disposition
38	C1	2784+29	Brokaw Ave	Sempra Energy Company	Natural Gas	2	inch	92	Relocated
39	C1	2806+40	Pickerell Ave	Sempra Energy Company	Natural Gas	4	inch	75	Relocated
40	C2	2708+25	Newark Ave	Sempra Energy Company	Natural Gas	2	inch	174	Relocated
41	C2	2718+95	5½ Ave	Sempra Energy Company	Natural Gas	6	inch	182	Relocated
42	C2	2719+17	5½ Ave	PG&E	Transmission Lines	115	kV	182	Relocated
43	C2	2734+81 to 2740+57	-	PG&E	Transmission Lines	115	kV	591	Relocated
44	C2	2765+63	Orange Ave	PG&E	Transmission Lines	110	kV	171	Relocated
45	C2	2997+44	Poplar Ave	Sempra Energy Company	Natural Gas	8	inch	164	Relocated
46	P	3381+04 to 3388+28	-	PG&E	Transmission Lines	115	kV	914	Relocated
47	A1	4380+08	Avenue 16	Sempra Energy Company	Natural Gas	10	inch	161	Relocated
48	A1	4761+14	Magnolia Ave	Sempra Energy Company	Natural Gas	3	inch	257	Relocated
49	A1	4786+60	Pond Road	Sempra Energy Company	Natural Gas	3	inch	149	Relocated
50	A1	4843+78	Peterson Road	Sempra Energy Company	Natural Gas	3	inch	135	Relocated
51	L1	5204+32 to 5208+83	-	Sempra Energy Company	Natural Gas	4	inch	462	Relocated

No.	HSR Alignment	Station	Cross Road(s)	Owner	Facility Type	Size	Units	Length (feet)	Disposition
52	L1	5218+07	Blankenship Ave	Unknown	Natural Gas	-	inch	233	Relocated
53	WS1	5517+03	-	PG&E	Transmission Line	115	kV	387	Relocated
54	WS1	5522+31	-	PG&E	Transmission Line	69	kV	137	Relocated
55	WS1	5996+83	Lerdo Highway	Unknown	Natural Gas	-	inch	113	Relocated
56	WS1	6013+59	Ash Ave	Sempra Energy Company	Natural Gas	4	inch	113	Relocated
57	WS1	6022+00	-	Sempra Energy Company	Natural Gas	16	inch	119	Relocated
58	WS1	6022+71	-	Unknown	Natural Gas	-	inch	124	Relocated
59	WS1	6031+20	S. Beech Ave	Unknown	Natural Gas	-	inch	471	Relocated
60	WS1	6031+45	S. Beech Ave	Sempra Energy Company	Natural Gas	-	inch	227	Relocated
61	WS1	6142+32	Burbank Street	Unknown	Petroleum	-	inch	163	Relocated
62	WS1	6154+19 to 6313+86	Burbank Street	Unknown	Petroleum	-	inch	15,969	Relocated
63	WS1	6246+71	-	PG&E	Transmission Line	115	kV	200	Relocated
64	WS1	6269+26	Roxy Lane	Shell Oil Company	Petroleum	14	inch	203	Relocated
65	WS1	6289+82	-	Unknown	Natural Gas	-	inch	137	Relocated
66	WS1	6289+97	-	Unknown	Petroleum	-	inch	137	Relocated
67	WS1	6292+17	Bowles Street	Unknown	Petroleum	-	inch	192	Relocated
68	WS1	6292+48	Bowles Street	Unknown	Petroleum	-	inch	192	Relocated

No.	HSR Alignment	Station	Cross Road(s)	Owner	Facility Type	Size	Units	Length (feet)	Disposition
69	WS1	6293+28	-	Unknown	Petroleum	-	inch	191	Relocated
70	WS1	6293+52	-	Unknown	Natural Gas	-	inch	187	Relocated
71	WS1	6293+73	-	Unknown	Petroleum	-	inch	184	Relocated
72	WS1	6297+86	-	Shell Oil Company	Petroleum	-	inch	192	Relocated
73	WS1	6302+18	-	Exxon Mobil Corp	Petroleum	6	inch	590	Relocated
74	WS1	6407+03	Rudd Ave	Sempra Energy Company	Natural Gas	-	inch	197	Relocated
75	WS1	6426+02	-	Conoco Philips	Petroleum	8	inch	193	Relocated
76	WS1	6429+55	-	Shell Oil Company	Petroleum	12	inch	193	Relocated
77	WS1	6442+89	Reina Street	Unknown	Natural Gas	-	inch	192	Relocated
78	WS1	6448+54	-	Sempra Energy Company	Natural Gas	-	inch	194	Relocated
79	WS1	6485+05	-	Unknown	Natural Gas	-	inch	196	Relocated
80	WS1	6487+39	-	Sempra Energy Company	Natural Gas	24	inch	199	Relocated
81	WS1	6503+95	-	Sempra Energy Company	Natural Gas	16	inch	197	Relocated
82	B3	6815+12	-	Sempra Energy Company	Natural Gas	-	inch	191	Relocated
83	B3	6836+09	-	Chevron Corp.	Petroleum	10	inch	131	Relocated
84	B3	6845+86	-	PG&E	Natural Gas	12	inch	198	Relocated
85	B3	6847+13	-	PG&E	Transmission Line	230	kV	198	Relocated

No.	HSR Alignment	Station	Cross Road(s)	Owner	Facility Type	Size	Units	Length (feet)	Disposition
86	B3	6851+17	-	PG&E	Natural Gas	-	inch	198	Relocated
87	B3	6852+83	-	Sempra Energy Company	Natural Gas	10	inch	135	Relocated
88	B3	6854+76	-	PG&E	Transmission Line	230	kV	199	Relocated
89	B3	6862+56	-	PG&E	Transmission Line	115	kV	193	Relocated
90	B3	6870+36	-	PG&E	Transmission Line	115	kV	202	Relocated
91	B3	6876+74 to 6896+09	-	Unknown	Petroleum	-	inch	2,336	Relocated
92	B3	6878+14	-	PG&E	Transmission Line	230	kV	202	Relocated
93	B3	6880+15	Rosedale Highway	PG&E	Transmission Line	-	kV	215	Relocated
94	B3	6911+80	-	Shell Oil Company	Petroleum	8	inch	166	Relocated
95	B3	6918+48 to 6921+79	-	Unknown	Petroleum	-	inch	323	Relocated
96	B3	6926+09	Palm Ave	Shell Oil Company	Petroleum	6	inch	197	Relocated
97	B3	6932+45	Palm Ave	Shell Oil Company	Petroleum	10	inch	156	Relocated
98	B3	6945+93	Slikker Drive	PG&E	Transmission Line	-	kV	90	Relocated
99	B3	6974+89	-	PG&E	Transmission Line	230	kV	84	Relocated
100	B3	6980+39	-	PG&E	Transmission Line	230	kV	83	Relocated
101	B3	6985+84	-	PG&E	Transmission Line	69	kV	83	Relocated

No.	HSR Alignment	Station	Cross Road(s)	Owner	Facility Type	Size	Units	Length (feet)	Disposition
102	B3	6988+80	-	BP West Coast Products LLC	Petroleum	10	inch	282	Relocated
103	B3	6991+25	-	PG&E	Transmission Line	69	kV	82	Relocated
104	B3	6996+63	-	PG&E	Transmission Line	69	kV	82	Relocated
105	B3	7000+18	-	Unknown	Natural Gas	-	inch	82	Relocated
106	B3	7001+39 to 7009.84	-	Unknown	Natural Gas	-	inch	850	Relocated
107	B3	7001+71	Brimhall Road	Shell Oil Company	Petroleum	10	inch	192	Relocated
108	B3	7002+00	Brimhall Road	PG&E	Transmission Line	115	kV	196	Relocated
109	B3	7007+33	-	PG&E	Transmission Line	115	kV	81	Relocated
110	B3	7012+17 to 7020.34	-	Unknown	Natural Gas	-	inch	829	Relocated
111	B3	7017+90	-	Conoco Phillips	Petroleum	-	inch	337	Relocated
112	B3	7021+33	-	Sempra Energy Company	Natural Gas	-	inch	241	Relocated
113	B3	7022+89	-	Shell Oil Company	Petroleum	4	inch	310	Relocated
114	B3	7030+64	-	Shell Oil Company	Petroleum	-	inch	100	Relocated
115	B3	7052+28	-	Sempra Energy Company	Natural Gas	8	inch	81	Relocated
116	B3	7070+08 to 7073+84	-	PG&E	Transmission Line	69	kV	384	Relocated

No.	HSR Alignment	Station	Cross Road(s)	Owner	Facility Type	Size	Units	Length (feet)	Disposition
117	B3	7094+25 to 7098+68	-	PG&E	Transmission Line	115	kV	453	Relocated
118	B3	7095+59 to 7101+18	-	Unknown	Transmission Line	-	kV	571	Relocated
119	B3	7102+70	-	Shell Oil Company	Petroleum	10	inch	81	Relocated
120	B3	7102+70 to 7109+60	-	Shell Oil Company	Petroleum	4	inch	706	Relocated
121	B3	7102+78 to 7103+49	-	Unknown	Transmission Line	-	kV	74	Relocated
122	B3	7112+15 to 7120+18		Shell Oil Company	Petroleum	4	inch	1,298	Relocated
123	B3	7112+15 to 7125+19	-	PG&E	Transmission Line	115	kV	1,529	Relocated
124	B3	7112+15 to 7118+59	-	PG&E	Transmission Line	115	kV	671	Relocated
125	B3	7117+49 to 7121+51	-	PG&E	Transmission Line	115	kV	225	Relocated
126	B3	7121+50 to 7123+64	-	PG&E	Transmission Line	115	kV	256	Relocated
127	B3	7125+83 to 7126+72	-	PG&E	Transmission Line	115	kV	123	Relocated
128	B3	7133+44	-	Shell Oil Company	Petroleum	10	inch	80	Relocated
129	B3	7135+34 to 7142+30	-	PG&E	Transmission Line	-	kV	699	Relocated
130	B3	7153+61	-	PG&E	Transmission Line	-	kV	88	Relocated

No.	HSR Alignment	Station	Cross Road(s)	Owner	Facility Type	Size	Units	Length (feet)	Disposition
131	B3	7159+40	Oak Street	PG&E	Transmission Line	69	kV	88	Relocated
132	B3	7162+91	Oak Street	PG&E	Transmission Line	-	kV	102	Relocated
133	B3	7260+08 to 7264+11	-	PG&E	Transmission Line	-	kV	568	Relocated
134	B3	7267+94 to 7268+42	-	Kinder Morgan	Petroleum	-	inch	349	Relocated
135	B3	7269+65	Union Ave	PG&E	Transmission Line	69	kV	690	Relocated
136	B3	7270+92 to 7278+00	-	Kinder Morgan	Petroleum	-	inch	1,556	Relocated
137	B3	7279+25	Dolores Street	PG&E	Natural Gas	12	inch	273	Relocated

Table 13.4-2
F-B Special Utility Consideration Due To Depressed HSR Alignment

HSR Alignment	HSR Station Range	Impacted Utility	Utility Owner	Utility Specs	Existing Conditions Description
F1	371+00	Electric Line - Overhead	PG&E	-	Overhead wire runs east-west across HSR
	371+82	Electric Line - Overhead	PG&E	-	Overhead wire runs east-west across HSR
	371+83	Storm Drain Pipe	FMFCD	30" Diameter	Pipe runs east-west across HSR
	380+20	Water Pipe	City of Fresno	10" Diameter	Pipe runs east-west across HSR
	380+20	Water Pipe	City of Fresno	12" Diameter	Pipe runs north-south across HSR
	380+40	Storm Drain Pipe	FMFCD	84" Diameter	Pipe runs east-west across HSR
	380+60	Sewer Pipe	City of Fresno	10" Diameter	Pipe runs east-west across HSR

HSR Alignment	HSR Station Range	Impacted Utility	Utility Owner	Utility Specs	Existing Conditions Description
	381+10	Electric Line - Overhead	PG&E	-	Overhead wire runs east-west across HSR
	381+80	Sewer Pipe	City of Fresno	30" Diameter	Pipe runs east-west across HSR
	381+20 to 387+60	Water Pipe	City of Fresno	12" Diameter	Pipe runs parallel HSR alignment
	383+80 to 387+30	Storm Drain Pipe	FMFCD	42" Diameter	Pipe runs parallel HSR alignment
	387+30 to 400+10	Storm Drain Pipe	FMFCD	36" Diameter	Pipe runs parallel HSR alignment
	386+40	Electric Line - Overhead	PG&E	115 kV	Overhead wire runs east-west across HSR
	387+10	Electric Line - Overhead	PG&E	69 kV	Overhead wire runs east-west across HSR
	387+30	Storm Drain Pipe	FMFCD	24" Diameter	Pipe runs east-west and north-south across HSR
	387+45	Water Pipe	City of Fresno	12" Diameter	Pipe runs north-south across HSR
	387+90	Electric Line - Overhead	PG&E	-	Overhead wire runs east-west across HSR
	400+10	Storm Drain Pipe	FMFCD	18" Diameter	Pipe runs east-west across HSR
	415+70	Sewer Pipe	City of Fresno	48" Diameter	Pipe runs east-west across HSR
	416+20	Storm Drain Pipe	Unknown	24" Diameter	Pipe runs east-west across HSR
	418+50	Electric Line - Overhead	PG&E	-	Overhead wire runs east-west across HSR
	422+45	Electric Line - Overhead	PG&E	-	Overhead wire runs east-west across HSR
	425+05	Electric Line - Overhead	PG&E	-	Overhead wire runs east-west across HSR

HSR Alignment	HSR Station Range	Impacted Utility	Utility Owner	Utility Specs	Existing Conditions Description
	429+50	Electric Line - Overhead	PG&E	-	Overhead wire runs east-west across HSR

Table 13.4-3
F-B Special Utility Consideration Due To Roadway Underpass

HSR Alignment	Road Name	Road Alignment	Station Range	Impacted Utility	Utility Owner	Utility Specs	Existing Conditions Description
F1	Fresno Street	FFS	9+00 to 12+50	Storm Drain Pipe	FMFCD	18" Diameter	Pipe runs southwest-northeast along Fresno Street
		FFS	9+00 to 11+00	Sewer Pipe	City of Fresno	10" Diameter	Pipe runs southwest-northeast along Fresno Street
		FFS	10+80	Water Pipe	City of Fresno	8" Diameter	Pipe runs southeast-northwest across Fresno Street
		FFS	10+90	Sewer Pipe	City of Fresno	8" Diameter	Pipe runs southeast-northwest across Fresno Street
		FFS	12+20 to 12+70	Storm Drain Pipe	FMFCD	15" Diameter	Pipe runs southeast-northwest along Fresno Street
		FFS	9+00 to 12+70	Water Pipe	City of Fresno	12" Diameter	Pipe runs southwest-northeast along Fresno Street
		FFS	12+80	Water Pipe	City of Fresno	12" Diameter	Pipe runs southeast-northwest across Fresno Street

HSR Alignment	Road Name	Road Alignment	Station Range	Impacted Utility	Utility Owner	Utility Specs	Existing Conditions Description
		FFS	12+80 to 17+00	Water Pipe	City of Fresno	12" Diameter	Pipe runs southwest-northeast along Fresno Street
		FFS	13+60	Oil (Abandoned)	Chevron	Unknown	Pipe runs southeast-northwest across Fresno Street
		FFS	15+20	Electric Line - Overhead	Unknown	-	Overhead wire runs southeast-northwest across Fresno Street
		FFS	15+20	Electric Line - Overhead	Unknown	-	Overhead wire runs southwest-northeast along Fresno Street
		FFS	16+60	Oil	Kinder Morgan Inc	12" Diameter	Pipe runs southeast-northwest across Fresno Street
		FFS	16+70	Fiber-Optic	Level 3 Communi-cation	-	Pipe runs southeast-northwest across Fresno Street
	Tulare Street	FTU	9+15	Water Pipe	City of Fresno	8" Diameter	Pipe runs north-south parallel F Street
		FTU	9+15 to 11+05	Water Pipe	City of Fresno	6" Diameter	Pipe runs parallel Tulare Street
		FTU	11+05	Water Pipe	City of Fresno	6" Diameter	Pipe runs north-south parallel China Alley
		FTU	13+26	Water Pipe	City of Fresno	10" Diameter	Pipe runs north-south parallel G Street

HSR Alignment	Road Name	Road Alignment	Station Range	Impacted Utility	Utility Owner	Utility Specs	Existing Conditions Description
		FTU	19+60	Water Pipe	City of Fresno	12" Diameter	Pipe runs north-south parallel H Street
		FTU	19+05	Storm Drain Pipe	FMFCD	15" Diameter	Pipe runs north-south parallel F Street
		FTU	9+00 to 13+07	Storm Drain Pipe	FMFCD	72" Diameter	Pipe runs parallel Tulare Street
		FTU	19+85	Storm Drain Pipe	FMFCD	42" Diameter	Pipe runs north-south parallel H Street
		FTU	9+18	Sewer Pipe	City of Fresno	4" Diameter	Pipe runs north-south parallel F Street
		FTU	9+00 to 11+00	Sewer Pipe	City of Fresno	10" Diameter	Pipe runs parallel Tulare Street
		FTU	11+00	Sewer Pipe	City of Fresno	8" Diameter	Pipe runs north-south parallel China Alley
		FTU	13+21	Sewer Pipe	City of Fresno	8" and 10" Diameter	Pipe runs north-south parallel H Street. North of intersection 8" pipe and 10" pipe south of intersection
		FTU	19+71	Sewer Pipe	City of Fresno	18" and 8" Diameter	Pipe runs north-south parallel G Street. North of intersection 18" pipe and 8" pipe south of intersection
		FTU	11+00	Electric Line - Overhead	PG&E	-	Overhead wire runs north-south parallel China Alley

HSR Alignment	Road Name	Road Alignment	Station Range	Impacted Utility	Utility Owner	Utility Specs	Existing Conditions Description
		FTU	13+30	Electric Line - Overhead	PG&E	-	Overhead wire runs north-south parallel G Street
		FTU	13+30 to 19+20	Electric Line - Overhead	PG&E	-	Overhead wire runs parallel Tulare Street
		FTU	15+30	Telecommu nication Wire	Unknown	-	Overhead wire runs north-south parallel HSR
		FTU	16+00	Petroleum	Unknown	Unknown	Pipe runs north-south parallel HSR
		FTU	16+00	Fiber-Optic	Level 3 Communi-cation	-	Wire runs north-south parallel HSR
C2	SR 137	SR 137	11+20 to 34+00	Electric Line - Overhead	Unknown	-	Overhead wire runs west-east along SR 137
WS1	Kimberlina Ave	KBA	11+20	Electric Line - Overhead	Unknown	-	Overhead wire runs north-south across Kimberlina Road
		KBA	11+20 to 31+00	Electric Line - Overhead	Unknown	-	Overhead wire runs west-east along Kimberlina Road
		KBA	13+00	Irrigation Line	Shafter-Wasco Irrigation District	Unknown	Pipe runs north-south across Kimberlina Road
		KBA	16+30	Telecom-munication Wire	Unknown	-	Wire runs north-south along Kimberlina Road
		KBA	16+60	Telecom-munication Wire - Overhead	Unknown	-	Wire runs southeast-northwest across Kimberlina Road

HSR Alignment	Road Name	Road Alignment	Station Range	Impacted Utility	Utility Owner	Utility Specs	Existing Conditions Description
		KBA	22+30	Electric Line - Overhead	Unknown	-	Wire runs north-south across Kimberlina Road
		KBA	27+90	Electric Line - Overhead	Unknown	-	Overhead wire runs north-south across Kimberlina Road

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Section 14.0

Maintenance and Support Facilities

14.0 Maintenance and Support Facilities

Three maintenance facilities and three potential HMFs are located within the FB Section. Table 14.0-1 includes a list of the maintenance facilities.

Crossovers would be located adjacent to the maintenance facilities with the following considerations:

- Crossovers would desirably be rated at 110 mph to increase operational flexibility.
- Crossovers would be ideally located greater than 750 feet from a roadway overcrossing.

14.1 Maintenance of Infrastructure Facility F1/M

A MOIF is proposed to be located south of Fresno on the west side of the HSR between approximate Stations 565+17 (F1) and 653+70 (M). This location is constrained to the north by a horizontal curve. The primary facilities of the MOIF would be located between East American Avenue and East Lincoln Avenue; so only the lead track would pass beneath the roadway overcrossings to limit the span lengths. The MOIF would have 50-mph connections to the mainline at both ends (No. 20 turnouts). The MOIF would consist of six double-end connected sidings of varying lengths between 930 feet and 3,683 feet. The sidings typically would be spaced 30 feet apart with 25-mph turnouts (No. 11 turnouts). A single-ended siding of 570 feet in length with 40 feet spacing would serve a ramp/dock.

Two roads to the facility would be provided from S Cedar Avenue and access roads would be provided from the facility to the mainline switches. The north turnout would be located north of the East American Avenue overcrossing, which would span over the MOIF north lead track and access road. The Washington Colony Canal, located to the south of the MOIF, would cross beneath the tracks and constrain the vertical alignment. The mainline grade is -0.053%.

Two 110-mph crossovers are proposed to serve the MOIF. The southern crossover would be located immediately south of the MOIF turnout and is constrained by the proximity of a vertical curve and E Adams Avenue. A northern crossover would be located north of Lincoln Avenue, between the MOIF turnouts. The separation between the mainline and MOIF lead track would be increased to approximately 90 feet to locate the crossover interlocking houses between the tracks.

14.2 Maintenance of Infrastructure Facility WS1

A MOIF site is proposed on the WS1 alignment between approximate Stations 6140+43 and 6219+47. The lead track would be connected to the mainline by 50-mph (No.20) turnouts.

The location of the MOIF site is constrained by the geometry resulting from the BNSF crossing to the north. The northern turnout is on a -0.815% grade and on a retained embankment. The turnout location is constrained by a horizontal curve to the north, Burbank Street overcrossing, and a vertical curve to the south.

Santa Fe Way would be realigned around the MOIF and two access roads would be provided to the MOIF from the realigned Santa Fe Way. The MOIF would be partially within the Widenbach Street floodplain and would be raised sufficiently to exceed the WSE.

The MOIF site layout would consist of six double-ended sidings of varying lengths at 30-foot typical track spacings, and one single-ended track with 40-foot track spacing. The turnouts within the facility would be 25 mph (No. 11 turnouts).

Two 110-mph crossovers would be located south of the southernmost MOIF turnout. A crossover could not be located within 0.5 miles of the northern MOIF turnout because the proposed alignment would rise on to a viaduct to cross the BNSF.

14.3 Maintenance of Infrastructure Siding C2/P

A maintenance of infrastructure siding (MOIS) would be located south of Corcoran on the west side of the HSR between approximate Stations 3091+35 (C2) and 3112+38 (P). The MOIS is constrained by the proposed HSR crossing of the BNSF and Tule River to the north, and Avenue 128 overcrossing to the south. The siding would have a usable length of 1,600 feet between the clearance points of the turnouts, and would have 50-mph connections to the mainline at both ends (No. 20 turnouts). A single-ended tail track of approximately 450 feet would be connected to the siding. An existing canal would be realigned along the west side of the MOIS. The mainline grade is -0.032%.

The MOIS would be served by 110-mph universal crossovers located approximately 0.45 miles to the south and a single 60-mph crossover located immediately to the north of the MOIS site. The northern crossover is constrained by the vertical alignment associated with the Tule River crossing.

14.4 Heavy Maintenance Facilities

There are three potential HMF sites within the FB Section:

- F1/M between approximate Stations 490+00 and 486+00 co-located with the MOIF site
- H/K4 between approximate Stations 2085+00 and 2120+00
- WS1 between approximate Stations 4166+00 and 4274+00 co-located with the MOIF site

Only one HMF site is required on the network and its location has not been determined. A nominal footprint has been allocated to each HMF site option, but the layout has not been developed and the grade separated connections have not been determined. The HMF design will be developed in a separate HMF environmental document.

If the HMF site were located in WS1 or F1/M, it could either replace or be in addition to the MOIF.

Table 14.0-1
Maintenance Facilities

Location (City/County And Beg. Station)	Type (MOE, MOI, HMF, etc.)	Level (1-5)	Size	Special Design Considerations
Fresno County Stations 565+17 (F1) and 653+70 (M)	MOIF	N/A	27 Acres	Proximity of Crossovers Clearance over canals
Corcoran Stations 3091+35 (C2) and 3112+38 (P)	MOIS	N/A	6.4 Acres	Proximity of Crossovers
Wasco Shafter Stations 6140+43 and 6219+47	MOIF	N/A	38 Acres	Proximity of crossovers Flood protection

Section 15.0

System Facilities

15.0 System Facilities

The traction power would be provided to the system through TPSSs, switching stations (SWS) and paralleling stations (PS). In accordance with the design guidance provided in TM 3.1.1.3, the following maximum spacing requirements have been observed for the traction power facilities (TPFs):

- TPSS – 30 miles from nearest TPSS
- SWS – 15 miles from nearest TPSS
- PS – 5 miles intervals between TPSS and SWS sites

Both TPSS and SWS sites would feature phase breaks that are located in accordance with the requirements of the March 25, 2010, memo *Guidance – Location of Phase Breaks (Associated with Substation and Switching Station)*. The exact location of the phase break relative to the TPF has not been determined at this phase.

Per the design guidance available in TM 3.3.2, interlocking houses would be located to serve each mainline crossover, station crossover, station turnout, and storage track.

Each TPF and master interlocking house would be equipped with a radio communications tower. These towers would be supplemented, where necessary, by stand-alone radio sites (SRS) to maintain the maximum radio tower spacing of 3.0 miles set out in the August 25, 2011, memo Requirements for Identification of Standalone Radio Site and 2.5 Mile Interval.

15.1 Facility Access

Per TM 2.8.1 and 2.8., vehicle access would be provided to each facility from a public road. Table 15.4-1 cites the proposed public road connection. Access roads would be designed to provide vehicle turnaround capability, and vehicle access to the HSR right-of-way where required.

15.2 TPSS Supply

Each TPSS site would be near existing transmission lines that are proposed as possible HV connection points to meet HSR electrical requirements.

15.2.1 TPSS501 (McCall TPSS)

The McCall TPSS site would be situated adjacent to multiple PG&E transmission lines. The Ponche-McCall and Henrietta-McCall transmission lines both would be 230kV.

15.2.2 TPSS502 (Jackson TPSS)

The Jackson TPSS site would be situated adjacent to the Henrietta-Kingsburg 115kV transmission line.

15.2.3 TPSS503 (Alpaugh TPSS)

The Alpaugh TPSS site would be situated adjacent to the Corcoran-Smyrna 115kV transmission line. It is anticipated that this line would require significant reconstruction to meet the needs of the HSR Project.

15.3 Interlocking Facilities

Wherever practical, the environmental footprint for interlocking facilities has been expanded along the length of the turnout or crossover. This expansion is intended to provide flexibility with regards to future changes to crossover speeds.

15.4 Special Design Considerations

15.4.1 Optional sites

Two sites have been identified at each location for TPFs and stand-alone radio sites provide flexibility in the ultimate site selection. Table 15.4-1 lists these sites.

15.4.2 Maintenance Facilities

MOIFs and an option for HMFs are proposed within the FB Section, as discussed in Section 14.0 of this report. These facilities tentatively have been located at the 15% design phase, and the necessary interlocking facilities have been evaluated to determine appropriate environmental footprint requirements.

15.4.3 At-Grade Facility Requirements

Per TM 3.1.1.3, it is desirable to locate facilities along at-grade track sections to minimize construction costs. Due to the general topography of the region and the presence of floodplains along the alignment, the majority of TPFs would be along embankment of varying heights. As such, there is opportunity to optimize the design with regards to construction costs at a later design phase by moving facilities to at-grade track sections where those sections are within the facility spacing requirements. Such opportunities are minimal, but a preliminary assessment of facilities that would warrant further study in this regard has been performed, and Table 15.4-1 lists the best candidates.

Table 15.4-1
Sites for Traction Power Facilities, Radio Tower, and Interlocking Houses

Alignment Subsection	Approximate Stationing	Facility Type	Facility Name	Cross-Section Type	Spacing to Previous	Spacing to Next	Access Road Outlet	Remarks
F1	257+50	Master Interlocking House	N/A	At-Grade	1.1	1.07	G Street	
F1	270+50	Type B Interlocking House	N/A	At-Grade	N/A	N/A	G Street	
F1	294+75	Type C Interlocking House	N/A	At-Grade	N/A	N/A	G Street	
F1	305+75	Type B Interlocking House	N/A	At-Grade	N/A	N/A	G Street	
F1	314+00	Paralleling Station	PS521 (Ventura PS)	At-Grade	3.5	5.08	G Street	
F1	317+50	Master Interlocking House	N/A	Embankment	1.07	0.48	G Street	
F1	330+00	Type B Interlocking House	N/A	Embankment	N/A	N/A	G Street	
F1	342+75	Master Interlocking House	N/A	Embankment	0.48	1.82	S Cherry Ave	Mainline Crossover: 2.25 to Fresno Station Crossover 10.67 to RT3
F1	353+75	Type B Interlocking House	N/A	Embankment	N/A	N/A	E Florence Ave	

Alignment Subsection	Approximate Stationing	Facility Type	Facility Name	Cross-Section Type	Spacing to Previous	Spacing to Next	Access Road Outlet	Remarks
F1	437+00	Stand Alone Radio Site	SRS 1 West Option	Retained Fill	1.79	2.75	S Golden State Blvd	
F1	438+75	Stand Alone Radio Site	SRS 1 East Option	Retained Fill	1.82	2.71	S Golden State Blvd	
F1	564+00	Master Interlocking House	N/A	Embankment	N/A	N/A	S Cedar Ave	
F1	573+00	Paralleling Station	PS 522 (American PS) North Option	Embankment	4.91	4.92	E American Ave	
F1	582+00	Paralleling Station	PS 522 (American PS) South Option	Embankment	5.08	4.75	E American Ave	
F1	611+25	Type B Interlocking House	N/A	Embankment	N/A	N/A	S Cedar Ave	
M	655+75	Master Interlocking House	N/A	Embankment	N/A	N/A	S Cedar Ave	
M	669+50	Type B Interlocking House	N/A	Embankment	N/A	N/A	S Cedar Ave	
M	712+00	Stand-Alone Radio Site	SRS 2 North Option	Embankment	2.69	2.23	E Sumner Ave	
M	713+25	Stand-Alone Radio Site	SRS 2 South Option	Embankment	2.72	2.21	E Sumner Ave	

Alignment Subsection	Approximate Stationing	Facility Type	Facility Name	Cross-Section Type	Spacing to Previous	Spacing to Next	Access Road Outlet	Remarks
M	830+00	Traction Power Substation	TPSS 501 (McCall TPSS)	Embankment	4.92	4.92	E Springfield Ave	Phase Break: 16.9 to previous SWS 14.72 to next HV Supply: 26.9 to previous TPSS 26.83 to next
M	892+00	Type B Interlocking House	N/A	Embankment	N/A	N/A	E Floral Ave	
M	903+00	Master Interlocking House	RT3	Embankment	1.38	1.84	E Floral Ave	Mainline Crossover: 10.67 to RT2 21.88 to RT4B
M	915+00	Type B Interlocking House	N/A	Embankment	N/A	N/A	E Floral Ave	
M	991+50	Stand-Alone Radio Site	SRS 3 North Option	Embankment	1.68	1.87	E Mountain View Ave	
M	1000+25	Stand-Alone Radio Site	SRS 3 South Option	Embankment	1.84	1.70	S Chestnut Ave	
H	1085+00	Paralleling Station	PS 523 (Willow PS) North Option	Embankment	4.83	5.19	S Willow Ave	
H	1090+00	Paralleling Station	PS 523 (Willow PS) South Option	Retained Fill	4.92	5.09	S Willow Ave	
H	1212+00	Stand-Alone Radio Site	SRS 4 North Option	Embankment	2.41	2.78	S Minnewawa Ave	

Alignment Subsection	Approximate Stationing	Facility Type	Facility Name	Cross-Section Type	Spacing to Previous	Spacing to Next	Access Road Outlet	Remarks
H	1220+75	Stand-Alone Radio Site	SRS 4 South Option	Embankment	2.57	2.62	S Clovis Ave	
H	1343+50	Paralleling Station	PS 524 (Davis PS) North Option	Embankment	4.90	4.99	E Davis Ave	
H	1359+00	Paralleling Station	PS 524 (Davis PS) South Option	Embankment	5.19	4.70	E Davis Ave	
H	1463+00	Stand-Alone Radio Site	SRS 5 North Option	Retained Fill	2.26	2.73	SR 43	
H	1471+00	Stand-Alone Radio Site	SRS 5 South Option	Retained Fill	2.41	2.58	SR 43	
H	1576+50	Switching Station	SWS 511 (Cairo SWS) North Option	Viaduct	4.41	4.59	Cairo Ave	Phase Break: 14.14 to previous 12.75 to next
H	1607+00	Switching Station	SWS 511 (Cairo SWS) South Option	Retained Fill	4.99	4.02	North Ave	Phase Break: 14.72 to previous 12.17 to next
H	1697+00	Stand-Alone Radio Site	SRS 6A North Option	Embankment	2.28	2.31	Excelsior Ave	
H	1703+50	Stand-Alone Radio Site	SRS 6A South Option	Embankment	2.41	2.19	Excelsior Ave	
H	1811+00	Paralleling Station	PS 525 (Flint PS) North Option	Embankment	4.44	4.71	E Flint Ave	

Alignment Subsection	Approximate Stationing	Facility Type	Facility Name	Cross-Section Type	Spacing to Previous	Spacing to Next	Access Road Outlet	Remarks
H	1819+00	Paralleling Station	PS 525 (Flint PS) South Option	Embankment	4.59	4.55	E Flint Ave	
H	1835+75	Type B Interlocking House	N/A	Embankment	N/A	N/A	7½ Ave	
H	1847+50	Master Interlocking House	RT3A	Embankment	0.69	1.43	7½ Ave	
H	1859+25	Type B Interlocking House	N/A	Embankment	N/A	N/A	7½ Ave	
H	1923+00	Master Interlocking House	RT3B	Viaduct	1.43	1.06	Grangeville Blvd	
H	1931+25	Type B Interlocking House	N/A	Viaduct	N/A	N/A	Grangeville Blvd	
H	1938+75	Type C Interlocking House	N/A	Viaduct	N/A	N/A	Grangeville Blvd	
H	1960+00	Type C Interlocking House	N/A	Viaduct	N/A	N/A	Lacey Blvd	
H	1968+00	Type B Interlocking House	N/A	Viaduct	N/A	N/A	Lacey Blvd	

Alignment Subsection	Approximate Stationing	Facility Type	Facility Name	Cross-Section Type	Spacing to Previous	Spacing to Next	Access Road Outlet	Remarks
H	1979+00	Master Interlocking House	RT4A	Viaduct	1.06	1.51	7th Ave	
H	2047+25	Type B Interlocking House	N/A	Embankment	N/A	N/A	7th Ave	
H	2055+75	Paralleling Station	PS 525A (Houston PS) North Option	Embankment	4.64	3.67	7th Ave	
H	2058+50	Master Interlocking House	RT4B	Embankment	1.51	1.75	7th Ave	Mainline Crossover: 21.88 to RT3 22.00 to RT5
H	2059+50	Paralleling Station	PS 525A (Houston PS) South Option	Embankment	4.71	3.60	7th Ave	
H	2068+75	Type B Interlocking House	N/A	Embankment	N/A	N/A	7th Ave	
K4	2078+00	Stand-Alone Radio Site	SRS 6B North Option	At-Grade / Embankment	1.69	1.93	Iona Ave	
K4	2081+00	Stand-Alone Radio Site	SRS 6B South Option	At-Grade / Embankment	1.75	1.88	Iona Ave	
K4	2165+00	Traction Power Substation	TPSS 502 (Jackson TPSS) North Option	At-Grade / Embankment	3.39	4.38	Jackson Ave	Phase Break: 12.47 to previous 13.33 to next HV Supply: 26.54 to previous 23.22 to next

Alignment Subsection	Approximate Stationing	Facility Type	Facility Name	Cross-Section Type	Spacing to Previous	Spacing to Next	Access Road Outlet	Remarks
K4	2180+00	Traction Power Substation	TPSS 502 (Jackson TPSS) South Option	At-Grade / Embankment	3.67	4.10	Jackson Ave	Phase Break: 12.75 to previous 13.05 to next HV Supply: 26.83 to previous 22.93 to next
K4	2284+25	Stand-Alone Radio Site	SRS 7 East Option	At-Grade / Embankment	2.26	2.13	Kent Ave	
K4	2287+00	Stand-Alone Radio Site	SRS 7 West Option	At-Grade / Embankment	2.31	2.07	Kent Ave	
K4	2392+50	Paralleling Station	PS 526 (Lansing PS) North Option	At-Grade / Embankment	4.31	4.59	Lansing Ave	
K4	2396+50	Paralleling Station	PS 526 (Lansing PS) South Option	At-Grade / Embankment	4.38	4.51	Lansing Ave	
K4	2502+25	Stand-Alone Radio Site	SRS 8 North Option	Viaduct	2.08	2.51	SR 43	
K4	2507+75	Stand-Alone Radio Site	SRS 8 South Option	Viaduct	2.18	2.41	SR 43	
C2	2627+50	Paralleling Station	PS527 (Nevada PS) North Option	At-Grade / Embankment	4.52	4.50	Nevada Ave	
C2	2631+00	Paralleling Station	PS 527 (Nevada PS) South Option	At-Grade / Embankment	4.59	4.43	Nevada Ave	

Alignment Subsection	Approximate Stationing	Facility Type	Facility Name	Cross-Section Type	Spacing to Previous	Spacing to Next	Access Road Outlet	Remarks
C2	2745+00	Stand-Alone Radio Site	SRS 9 North Option	At-Grade / Embankment	2.23	2.27	5th Ave	
C2	2748+00	Stand-Alone Radio Site	SRS 9 South Option	At-Grade / Embankment	2.28	2.22	5th Ave	
C2	2852+00	Switching Station	SWS 512 (Oregon SWS) North Option	At-Grade / Embankment	4.25	5.06	Whitley Ave	Phase Break: 13.08 to previous 10.13 to next
C2	2865+00	Switching Station	SWS 512 (Oregon SWS) South Option	At-Grade / Embankment	4.50	4.81	SR 43	Phase Break: 13.33 to previous 9.89 to next
C2	2986+50	Stand-Alone Radio Site	SRS 10 North Option	Retained Fill	2.55	2.51	Avenue 144	
C2	2999+00	Stand-Alone Radio Site	SRS 10 South Option	Viaduct	2.78	2.27	Avenue 144	
C2	3083+75	Type B Interlocking House	N/A	Embankment	N/A	N/A	Avenue 128	
C2	3090+00	Master Interlocking House	N/A	Embankment	N/A	N/A	Avenue 128	
P	3114+50	Paralleling Station	PS 528 (Avenue 128 PS) North Option	At-Grade / Embankment	4.97	5.16	Avenue 128	

Alignment Subsection	Approximate Stationing	Facility Type	Facility Name	Cross-Section Type	Spacing to Previous	Spacing to Next	Access Road Outlet	Remarks
P	3119+00	Paralleling Station	PS 528 (Avenue 128 PS) South Option	At-Grade / Embankment	5.06	5.08	Avenue 128	
P	3134+00	Type B Interlocking House	N/A	At-Grade / Embankment	N/A	N/A	Hesse Ave	
P	3146+50	Master Interlocking House	RT5	At-Grade / Embankment	0.61	1.88	Hesse Ave	Mainline Crossover: 22.00 to RT4B 14.69 to RT6
P	3159+00	Type B Interlocking House	N/A	At-Grade / Embankment	N/A	N/A	Hesse Ave	
P	3238+75	Stand-Alone Radio Site	SRS 11 North Option	At-Grade / Embankment	1.75	2.81	Avenue 112	
P	3246+00	Stand-Alone Radio Site	SRS 11 South Option	At-Grade / Embankment	1.88	2.68	Avenue 112	
P	3369+00	Traction Power Substation	TPSS 503 (Alpaugh TPSS) North Option	At-Grade/ Embankment	4.82	3.94	Avenue 88	Phase Break: 9.79 to previous 13.04 to next HV Supply: 22.87 to previous 26.47 to next
P	3387+00	Traction Power Substation	TPSS 503 (Alpaugh TPSS) South Option	At-Grade/ Embankment	5.16	3.60	Avenue 88	Phase Break: 10.13 to previous 12.70 to next HV Supply: 23.22 to previous 26.13 to next

Alignment Subsection	Approximate Stationing	Facility Type	Facility Name	Cross-Section Type	Spacing to Previous	Spacing to Next	Access Road Outlet	Remarks
A1	3933+00	Stand-Alone Radio Site	SRS 12 North Option	At-Grade/ Embankment	1.96	1.98	Avenue 88	
A1	3948+25	Stand-Alone Radio Site	SRS 12 South Option	At-Grade/ Embankment	2.25	1.69	Avenue 88	
A1	4033+00	Paralleling Station	PS 529 (Stoil Spur PS) North Option	Viaduct	3.86	4.68	County Road J22	
A1	4037+50	Paralleling Station	PS 529 (Stoil Spur PS) South Option	Viaduct	3.94	4.59	County Road J22	
A1	4158+50	Stand-Alone Radio Site	SRS 13	At-Grade/ Embankment	2.38	2.30	County Road J22	Single site option only. Parcel size at this location is sufficiently large that it is not possible to provide an additional site option on a separate parcel that satisfies the spacing requirements.
A1	4276+00	Paralleling Station	PS 530 (Ave 36 PS) North Option	At-Grade / Embankment	4.60	4.58	Young Road	
A1	4280+00	Paralleling Station	PS 530 (Ave 36 PS) South Option	At-Grade / Embankment	4.68	4.50	Young Road	
A1	4369+00	Type B Interlocking House	N/A	At-Grade / Embankment	N/A	N/A	Young Road	
A1	4382+50	Master Interlocking House	RT6	At-Grade / Embankment	2.02	2.56	Young Road	Mainline Crossover: 14.69 to RT5 21.80 to RT7

Alignment Subsection	Approximate Stationing	Facility Type	Facility Name	Cross-Section Type	Spacing to Previous	Spacing to Next	Access Road Outlet	Remarks
A1	4395+75	Type B Interlocking House	N/A	At-Grade / Embankment	N/A	N/A	Young Road	
A1	4513+00	Switching Station	SWS 513 (Scofield SWS) North Option	At-Grade / Embankment	4.49	4.79	Scofield Ave	Phase Break: 12.95 to previous 13.52 to next
A1	4517+75	Switching Station	SWS 513 (Scofield SWS) South Option	At-Grade / Embankment	4.58	4.70	Scofield Ave	Phase Break: 13.04 to previous 13.43 to next
A1	4628+00	Stand-Alone Radio Site	SRS 14 North Option	At-Grade / Embankment	2.18	2.61	Garces Highway	
A1	4637+00	Stand-Alone Radio Site	SRS 14 South Option	At-Grade / Embankment	2.35	2.44	Woollomes Ave	
A1	4757+00	Paralleling Station	PS 531 (Magnolia PS) East Option	At-Grade / Embankment	4.53	4.44	Magnolia Ave	
A1	4766+00	Paralleling Station	PS 531 (Magnolia PS) West Option	At-Grade / Embankment	4.79	4.27	Magnolia Ave	
A1	4878+00	Stand-Alone Radio Site	SRS 15 (North Option)	At-Grade / Embankment	2.29	2.15	Peterson Road	
A1	4879+00	Stand-Alone Radio Site	SRS 15 (South Option)	At-Grade / Embankment	2.31	2.13	Peterson Road	

Alignment Subsection	Approximate Stationing	Facility Type	Facility Name	Cross-Section Type	Spacing to Previous	Spacing to Next	Access Road Outlet	Remarks
WS1	5424+50	Stand-Alone Radio Site	SRS 16 North Option	At-Grade / Embankment	2.03	2.49	Palm Ave	
WS1	5427+50	Stand-Alone Radio Site	SRS 16 South Option	At-Grade / Embankment	2.09	2.43	Palm Ave	
WS1	5513+00	Traction Power Substation	TPSS 504 (Charca/Paso Robles TPSS) North Option	At-Grade / Embankment	3.71	5.02	Annin Ave	Phase Break: 12.71 to previous 14.92 to next HV Supply: 25.66 to previous 25.00 to next
WS1	5556+00	Traction Power Substation	TPSS 504 (Charca/Paso Robles TPSS) South Option	Retained Fill	4.52	4.20	F Street	Phase Break: 13.52 to previous 14.11 to next HV Supply: 26.47 to previous 24.18 to next
WS1	5647+75	Stand-Alone Radio Site	SRS 17A North Option	Viaduct	2.55	2.47	SR 43	
WS1	5651+00	Stand-Alone Radio Site	SRS 17A South Option	Viaduct	2.61	2.41	SR 43	
WS1	5774+00	Paralleling Station	PS 533 (Dresser PS) North Option	At-Grade / Embankment	4.94	4.96	Poplar Ave	
WS1	5778+00	Paralleling Station	PS 533 (Dresser PS) South Option	At-Grade / Embankment	5.02	4.89	Poplar Ave	

Alignment Subsection	Approximate Stationing	Facility Type	Facility Name	Cross-Section Type	Spacing to Previous	Spacing to Next	Access Road Outlet	Remarks
WS1	5852+75	Type B Interlocking House	N/A	At-Grade / Embankment	N/A	N/A	Merced Ave	
WS1	5862+75	Master Interlocking House	RT7	At-Grade / Embankment	1.68	1.59	Merced Ave	Mainline Crossover: 21.80 to RT6 19.32 to RT8A
WS1	5875+75	Type B Interlocking House	N/A	At-Grade / Embankment	N/A	N/A	Merced Ave	
WS1	5946+50	Stand-Alone Radio Site	SRS 17B	Retained Fill	1.59	1.70	N Shafter Ave	Single site option only. Land use indicates a single owner for 1,500 feet along track. No separate parcel site option could be provided that would satisfy spacing requirements.
WS1	6028+75	Paralleling Station	PS 534 (Los Angeles PS) North Option	Viaduct	4.82	5.16	S Beech Ave	
WS1	6036+00	Paralleling Station	PS534 (Los Angeles PS) South Option	Viaduct	4.96	5.02	E Los Angeles Street	
WS1	6158+00	Stand-Alone Radio Site	SRS 18 North Option	At-Grade / Embankment	2.45	2.71	Santa Fe Way	
WS1	6160+75	Stand-Alone Radio Site	SRS 18 South Option	At-Grade / Embankment	2.50	2.66	Santa Fe Way	

Alignment Subsection	Approximate Stationing	Facility Type	Facility Name	Cross-Section Type	Spacing to Previous	Spacing to Next	Access Road Outlet	Remarks
WS1	6223+50	Type B Interlocking House	N/A	At Grade / Embankment	N/A	N/A	Santa Fe Way	
WS1	6235+50	Master Interlocking House	N/A	At Grade / Embankment	N/A	N/A	Santa Fe Way	
WS1	6247+25	Type B Interlocking House	N/A	At Grade / Embankment	N/A	N/A	Santa Fe Way	
WS1	6278+00	Switching Station	SWS 514 (7th Standard SWS) North Option	At-Grade / Embankment	4.72	5.22	Galpin Street	Phase Break: 14.49 to previous 10.51 to next Note that this site is near an at-grade section and may warrant study during the next design phase to determine if revisions to the May 2014 Record Set to relocate the site to the at-grade section would be justified due to construction cost savings.
WS1	6301+00	Switching Station	SWS514 (7th Standard SWS) South Option	At-Grade / Embankment	5.16	4.78	Santa Fe Way	Phase Break: 14.92 to previous 10.07 to next Note that this site is near an at-grade section and may warrant study during the next design phase to determine if revisions to the May 2014 Record Set to relocate the site to the at-grade section would be justified due to construction cost savings.

Alignment Subsection	Approximate Stationing	Facility Type	Facility Name	Cross-Section Type	Spacing to Previous	Spacing to Next	Access Road Outlet	Remarks
WS1	6430+50	Stand-Alone Radio Site	SRS 19	At-Grade / Embankment	2.89	2.33	Santa Fe Way	Single site option only. Parcel size at this location is sufficiently large that it is not possible to provide an additional site option on a separate parcel that satisfies the spacing requirements.
B3	6841+00	Paralleling Station	PS 535 (Snowberry PS)	At-Grade / Embankment	5.22	5.29	Old Farm Road	Single site option only. Parcel size at this location is sufficiently large that it is not possible to provide an additional site option on a separate parcel that satisfies the spacing requirements.
B3	6988+25	Stand Alone Radio Site	SRS 20	Viaduct	2.79	2.50	Brimhall Road	Single site option only. Parcel size at this location is sufficiently large that it is not possible to provide an additional site option on a separate parcel that satisfies the spacing requirements.
B3	7114+00	Traction Power Substation	TPSS 505 (West Park TPSS) North Option	Viaduct	5.17	5.14	Commerce Drive	Phase Break: 10.39 to previous 23.07 to next HV Supply: 24.88 to previous 14.97 to next
B3	7120+50	Traction Power Substation	TPSS 505 (West Park TPSS) South Option	Viaduct	5.29	5.02	Empire Drive	Phase Break: 10.51 to previous 22.95 to next HV Supply: 25.00 to previous 14.84 to next

Alignment Subsection	Approximate Stationing	Facility Type	Facility Name	Cross-Section Type	Spacing to Previous	Spacing to Next	Access Road Outlet	Remarks
B3	7158+25	Type B Interlocking House	N/A	Viaduct	N/A	N/A	Truxtun Ave	
B3	7170+50	Master Interlocking House	RT8A	Viaduct	1.07	1.54	16th Street	Mainline Crossover: 19.32 to RT7 3.84 to RT9A
B3	7182+50	Type B Interlocking House	N/A	Viaduct	N/A	N/A	16th Street	
B3	7251+50	Master Interlocking House	RT8B	Viaduct	1.54	0.90	S Street	
B3	7262+00	Type B Interlocking House	N/A	Viaduct	N/A	N/A	Station Access	
B3	7278+50	Type C Interlocking House	N/A	Viaduct	N/A	N/A	Inyo Street	
B3	7290+50	Type B Interlocking House	N/A	Viaduct	N/A	N/A	Kern Street	
B3	7299+00	Master Interlocking House	RT8C	Viaduct	0.90	1.41	King Street	
B3	7362+50	Type B Interlocking House	N/A	Viaduct	N/A	N/A	Edison Highway	

Alignment Subsection	Approximate Stationing	Facility Type	Facility Name	Cross-Section Type	Spacing to Previous	Spacing to Next	Access Road Outlet	Remarks
B3	7373+50	Master Interlocking House	RT9A	Viaduct	1.41	0.23	Edison Highway	Mainline Crossover: 3.84 to RT8A 8.7 to RT7 (B-P Segment)
B3	7381+50	Paralleling Station	PS 536 (Edison PS) North Option	Viaduct	5.07	5.5 (to Vineland PS in B-P Segment)	Exchange Street	
B3	7385+50	Paralleling Station	PS 536 (Edison PS) South Option	Viaduct	5.14	5.4 (to Vineland PS in B-P Segment)	Exchange Street	
B3	7387+00	Type B Interlocking House	N/A	Viaduct	N/A	N/A	Edison Highway	

Notes:
1. Traction power facility (PS, SWS, TPSS) spacings are taken as the worst-case spacing to the previous or next traction power facility.
2. Phase break facilities (SWS, TPSS) also include spacings taken as the worst-case spacing to the previous or next phase break facility.
3. High-voltage supply stations (TPSSs) also include spacings taken as the worst-case spacing to the previous or next high-voltage supply station.
4. Stand-alone radio site spacings are taken as the worst-case spacing to the previous or next radio tower (as found in traction power facilities, radio sites or master interlocking facilities).
5. Master interlocking facilities for mainline crossovers are given two spacings. The first is taken as the worst-case spacing to the previous or next master interlocking facility. The second is taken as the worst-case spacing to the previous or next radio tower.
6. Master interlocking facilities for station turnouts are listed to establish locations and access road outlets. The spacings are taken as the worst-case spacing to the previous or next radio tower.
7. Type B and Type C interlocking facilities are listed to establish locations and access road outlets, but do not cite any spacing to previous or next facilities as they are tied to specific track work, and their spacing from each other are not critical.

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Section 16.0

Design Variance

16.0 Design Variances

16.1 HSR Design Variances

Table 16.1-1 lists HSR design variances (URS/HMM/Arup 2013f).

Table 16.1-1
HSR Design Variances

No.	Location/ Station	Design Criteria Reference	Minimum Or Exceptional Standard Requiring Deviation	Variance Request	Constraint/ Justification	Approval Date
1	Stations 265+00 to 278+00 and 296+00 to 313+00	TM 1.1.21 Typical Cross Section – April 07, 2009, Rev 0	Requirement for lateral clearance for access to and along the right-of-way. Minimum condition is aerial structure (10 foot minimum); at-grade (10 foot minimum).	Provision of less than 10 feet of lateral clearance along the at-grade HSR corridor.	HSR track centerline is constrained by the offset at the station and the limited flexibility in alignment through urban Fresno. The position of the intrusion protection barrier is constrained by minimizing the encroachment into the UPRR right-of-way.	

No.	Location/ Station	Design Criteria Reference	Minimum Or Exceptional Standard Requiring Deviation	Variance Request	Constraint/ Justification	Approval Date
2	Stations 274+40.61 and 306+25.66	TM 2.1.2 Alignment Design Standards for High-Speed Train Operation - March 26, 2009, Rev 0, Sections 6.1.1 and 6.1.7	Where alignment segments overlap each segment shall be treated as a separate alignment element for the purpose of calculating minimum segment lengths. The desirable distance between end of spiral and beginning of vertical curve or end of vertical curve and beginning of spiral is 160 feet (50 meters) with a minimum limit of 100 feet (30 meters).	Provision of a distance less than the attenuation length between the end of the platform track return curve spiral and the vertical curve. North of the station, a 151-foot separation is provided. South of the station, the vertical curve would overlap the return curve and spiral. (see design variance request URS-OPS-0-0006)	The location of Fresno Station and the vertical geometry required to pass over Fresno Street underpass and pass beneath SR 41 to the south and Dry Creek/SR 180 to the north.	

No.	Location/ Station	Design Criteria Reference	Minimum Or Exceptional Standard Requiring Deviation	Variance Request	Constraint/ Justification	Approval Date
3	Stations325+00 and 409+00	TM 1.1.21 Typical Cross-Sections for 15% Design - August 19, 2013, Rev 1, Appendix A	For HSR passing under an existing structure, the minimum vertical clearance is 27 feet. For speeds less than 125 mph, the minimum vertical clearance is 24 feet.	24.5-foot minimum vertical clearance beneath an existing structure for HSR operating at 220 mph. (see design variance request URS-INF-1-0012)	The railway vertical alignment passes under the existing structures for SR 41 and E Jensen Bypass before climbing on to a viaduct to pass over Golden State Blvd. Lowering the track in this area would increase the buoyancy of the trench requiring a larger structure or anchor system. It would also conflict with storm drain and sewer utilities. Lowering under SR 41 could further expose column foundations. If the two bridges were rebuilt to provide a greater clearance, it would add substantial extra cost to the project and disruption during reconstruction.	
4	Station 405+00	TM 2.1.2 Alignment Design Standards for High-Speed Train Operation - March 26, 2009, Rev 0, Section 6.1.7	Overlap between vertical curves and spirals may be permitted as an exceptional condition.	Vertical curve in horizontal spiral.	The alignment passes underneath the existing E Jensen Bypass bridge before climbing on to a viaduct over Golden State Blvd. The vertical curve required for this movement overlaps with the horizontal curve discussed in design variance No.3.	

No.	Location/ Station	Design Criteria Reference	Minimum Or Exceptional Standard Requiring Deviation	Variance Request	Constraint/ Justification	Approval Date
5	Stations 408+00 to 409+50	TM 1.1.21 Typical Cross-Sections for 15% Design - August 19, 2013, Rev 1, Appendix B	Ditch shall conform to the following dimensions: Depth of ditch 1 foot minimum, slope of ditch sides 3H:1V maximum, width of ditch 4 foot minimum	Use of 3-foot-wide v-ditch adjacent to Jensen Trench.	There is limited clearance between the trench structure and the existing piers of E Jensen Bypass overbridge.	
6	Stations 410+00 to 540+00	TM 2.1.2 Alignment Design Standards for High-Speed Train Operation - March 26, 2009, Rev 0, Sections 6.1.5 Table 6.1.3	Minimum radius of 22,000 feet.	Design speed of 220 mph and exceptional horizontal curve radius of 21,297 feet. (see design variance request URS-INF-2-0005)	The alignment diverges from being parallel with UPRR to parallel the BNSF railway alignment. These two tangents are connected by a long horizontal curve. The curve should be as short as possible to minimize the impact on Fresno with possible impacts on Jensen Bypass bridge, two distribution warehouses and Cedar Avenue bridge. The curve is also located to avoid crossing Cedar avenue at the same location as the SR 99 crossing.	
7	Station 1485+60	TM 2.10.10 29 Feb 12, Draft Revision R1 Clause 2.1.2 and various other clauses	Preliminary track design philosophy per TM 2.1.5: Track Design [9] is to avoid rail expansion joints if practical. Thus, for preliminary design, the maximum limit from the fixed point to the free point of structure (i.e., structural thermal unit) is 330 feet.	At Cole Slough, a span of 350 feet is proposed to enable the structure to satisfy USACE requirements for clearance to its levee.	No part of the structure is permitted within 15 feet horizontally from the toe of the levee backslope.	

No.	Location/ Station	Design Criteria Reference	Minimum Or Exceptional Standard Requiring Deviation	Variance Request	Constraint/ Justification	Approval Date
8	Station 1518+30	TM 2.10.10 29 Feb 12, Draft Revision R1 Clause 2.1.2 and various other clauses	Preliminary track design philosophy per TM 2.1.5: Track Design [9] is to avoid rail expansion joints if practical. Thus, for preliminary design, the maximum limit from the fixed point to the free point of structure (i.e., structural thermal unit) is 330 feet.	At Dutch John Cut, two spans of 350 feet are proposed to enable the structure to satisfy USACE requirements for clearance to its levee.	No part of the structure is permitted within 15 feet horizontally from the toe of the levee backslope.	
9	Stations 1933+00 to 1937+00 and 1962+00 to 1966+00	TM 2.1.2 Alignment Design Standards for High-Speed Train Operation - March 26, 2009, Rev 0, Section 6.1.7	The desirable distance between end of spiral and beginning of vertical curve or end of vertical curve and beginning of spiral is 160 feet (50 meters) with a minimum limit of 100 feet (30 meters).	Beginning of platform track vertical curve is coincident with the end of spiral for the platform track return curve.	The position of the vertical curve is constrained between the storage track turnout and the platform track return curve. The location of the storage track turnout is fixed and requires 75 feet of separation between the station platforms and the beginning of the storage track turnout, as per TM 2.1.3-B. The position of the platform track turnout is 3,000 feet from the center of the platforms, as dictated by TM 2.1.3. Meeting the desirable attenuation length between the end of the return curve spiral and beginning of vertical curve would require the placement of vertical curve beyond the platform track turnouts and would require a significant increase in the viaduct length.	

No.	Location/ Station	Design Criteria Reference	Minimum Or Exceptional Standard Requiring Deviation	Variance Request	Constraint/ Justification	Approval Date
10	Stations 5656+71 to 5810+45	TM 2.1.2 Alignment Design Standards for High-Speed Train Operation - March 26, 2009, Rev 0, Sections 6.1.3 and 6.1.5	For speeds greater than 186 mph, the super elevations are: Desirable 4 inches Maximum 6 inches Exceptional 7 inches	Design speed of 220 mph and 6.5-inch super elevation on a curve.	The BNSF curvature is tighter than that achievable by the HSR criteria. To minimize impacts to the agricultural community, the PMT instructed that a tighter curve be utilized. Due to superimposition of a crest curve within the minimum radius horizontal curve, the unbalanced super elevation has been limited to 2.5 inches. This limitation required the applied super elevation to be increased above the maximum value.	

No.	Location/ Station	Design Criteria Reference	Minimum Or Exceptional Standard Requiring Deviation	Variance Request	Constraint/ Justification	Approval Date
11	Stations 6278+00, 6300+00 and 6430+00,	TM 3.1.1.3 Traction Power Facility General Standardization Requirements - 2010-06-11, Rev. 2	The trackside fence for all types of traction power facilities preferably should be located not more than 100 feet from the HSR right-of-way.	Santa Fe Way would be between the proposed 7th Standard Switching Stations (North and South Options) and the HSR right-of-way.	The design shows that HSR right-of-way would displace the existing Santa Fe Way. Santa Fe Way is proposed to be relocated to the west of, and adjacent to, the HSR right-of-way. The systems sites are proposed to be located to the west of the realigned SFW. If the systems site was to be placed adjacent to the HSR right-of-way, then Santa Fe Way would need to be relocated farther west. This additional relocation would require additional land take, which would affect the Heights Corner neighborhood and agricultural land.	
12	Stations 4159+00, 5946+50, 6431+00, 6841+00, and 6988+00	Verbal guidance from PMT	Traction power facilities shall have multiple options on separate parcels of land.	Allow a single site option for facilities at the following locations: SRS13 - A1, 4159+00 SRS17B - WS1, 5946+50 SRS19 - WS1, 6431+00 PS535 - B3, 6841+00 SRS20 - B3, 6988+00	Due to parcel sizes and constraints at the indicated locations, it is not possible to provide a second site option on a separate parcel that satisfies communications and traction power spacing requirements.	

No.	Location/ Station	Design Criteria Reference	Minimum Or Exceptional Standard Requiring Deviation	Variance Request	Constraint/ Justification	Approval Date
13	Stations 6887+00, 7075+00, 7090+00, and 7130+00	TM 2.1.2 Alignment Design Standards for High-Speed Train Operation - March 26, 2009, Rev 0, Sections 6.1.5.3 and 6.1.7	The length of the spiral shall be the longest length determined by calculating the various length requirements, which are: (1) length needed to achieve attenuation time; (2) length determined by allowed rate of change in super elevation; (3) length determined by allowed rate of change in unbalanced super elevation; and, (4) length determined by limitation on twisting over vehicle and truck spacing length. At this location, minimum requirement is 2,002 feet and exceptional requirement is 1,679 feet.	Use of exceptional design criteria for spiral lengths for curve numbers 121 and 122. Proposed length is 1,700, 1,707, 1,693, 1,700 feet, respectively.	Curve and spirals designed to stay north of the BNSF yard while also maintaining appropriate clearance to the south of Mercy Hospital due to the sensitivity of equipment used at that facility and the impact of vibrations from the HSR.	
14	Station 6893+66	TM 2.1.2 Alignment Design Standards for High-Speed Train Operation - March 26, 2009, Rev 0, Sections 6.1.2, 6.1.3, and 6.1.5	Minimum radius of 22,000 feet.	Exceptional horizontal curve radius of 19,508 feet for Curve 121.	Curve and spirals are designed to be as south as possible around the Flying J oil refinery, while avoiding the Bakersfield Commons project, minimizing the impact on Rosedale community south of the alignment and allowing proper integration and pier placement in the vicinity of the West Side Parkway.	

No.	Location/ Station	Design Criteria Reference	Minimum Or Exceptional Standard Requiring Deviation	Variance Request	Constraint/ Justification	Approval Date
15	Stations 6967+65 and 7110+42	TM 2.1.2 Alignment Design Standards for High-Speed Train Operation - March 26, 2009, Rev 0, Section 6.1.7	Unbalanced superelevation limits through vertical curves. Where a crest vertical curve is on a horizontal curve, the limits on unbalanced superelevation shall be reduced by 0.25 inches for the limiting value and 0.5 inches for the exceptional value.	The horizontal alignment is proposed with a 19,508-foot (Curve 121) / 19,680-foot (Curve 122) radius at 220 mph. This radius requires a balancing super elevation of 9.92 /9.84 inches. Both curves would have an applied super elevation of 7.00 inches, leaving an unbalanced super elevation of 2.92/2.84 inches. The exceptional maximum for unbalanced super elevation is 3 inches less the 0.5 inches due to the crest curve.	The 19,508-foot (Curve 121) / 19,680-foot (Curve 122) radius is required to minimize the impact on property in Bakersfield and to allow the crossovers to be provided on tangent track prior to Bakersfield Station. The vertical curve is required to provide clearance over SR 99.	

No.	Location/ Station	Design Criteria Reference	Minimum Or Exceptional Standard Requiring Deviation	Variance Request	Constraint/ Justification	Approval Date
16	Station 7019+00	TM - January 28, 2013, EMT to RC's DRAFT Maintenance Access Requirements	Minimum requirement for access to foundations is 10-foot clearance.	Provision of less than 10 feet of clearance around foundations. Culvert overlaps foundations.	Culvert is designed to match size of existing culvert, which is wider than the space between foundations. The pier cap would be placed below the canal bottom elevation. Canal diversion around structure not proposed because of hydraulic losses from a long diversion. There is insufficient information at this stage to determine if this would be a feasible option.	
17	Station 7098+52	TM 2.1.2 Alignment Design Standards for High-Speed Train Operation - March 26, 2009, Rev 0, Sections 6.1.2, 6.1.3, and 6.1.5	Minimum radius of 22,000 feet.	Exceptional horizontal curve radius of 19,680 feet for Curve 122.	Curve and spirals designed to stay north of the BNSF yard while also maintaining appropriate clearance to the south of Mercy Hospital.	
18	Station 7115+00	"Guidance - Location of Phase Breaks (Associated with Substation and Switching Stations)," March 25, 2010	Generally, phase breaks should be located on level tangent track of at least 2 miles in length, 2 miles from home signal of crossover, 2 miles from station platforms or tunnel portals. If not possible coordinate with EMT to determine suitable location.	Reduced phase break clearance distance of 4,500 feet between West Park TPSS and crossover/Bakersfield Station.	Due to the constraints of the horizontal geometry, the best suitable locations of West Park TPSS, Bakersfield Station, and the crossover north of the Bakersfield Station do not permit the required phase break distance of 2 miles.	
19	Stations 7122+00 to 7125+00	TM - January 28, 2013, EMT to RC's DRAFT Maintenance Access Requirements	Minimum requirement for access to foundations is 10-foot clearance.	Provision of less than 10 feet of clearance on the canal side of the foundation adjacent to Grant Canal.	Canal should be maintained straight.	

No.	Location/ Station	Design Criteria Reference	Minimum Or Exceptional Standard Requiring Deviation	Variance Request	Constraint/ Justification	Approval Date
20	Stations7186+13 to 7211+36, 7215+04 to 7249+59, and 7303+24 to 7357+67	TM 2.1.2 Alignment Design Standards for High-Speed Train Operation - March 26, 2009, Rev 0, Abstract	On these segments, speeds would be above 125 mph (200 km/h), up to a maximum operating speed of 220 mph (350 km/h), and would consider that faster operation up to not less than 250 mph (400 km/h) in the future would not be unnecessarily precluded.	130 mph for Curve 123; 125 mph for Curve 124; 145 mph for Curve 125.	The B3 alignment mitigates the following impacts: (1) avoids the Bakersfield High School Industrial Arts Building; (2) avoids several churches in East Bakersfield; and (3) minimizes community impacts in East Bakersfield. The B3 alignment accomplishes these criteria while still allowing a station campus to be placed west of Union Ave and allowing the 4-track section to be dropped prior to the back-to-back curvature for cost containment.	

No.	Location/ Station	Design Criteria Reference	Minimum Or Exceptional Standard Requiring Deviation	Variance Request	Constraint/ Justification	Approval Date
21	Station 7189+60	TM 2.1.3 Directive Drawings Typical Interlock Schematics - February 25, 2010, Rev 0, Drawing Interlock A	Maximum distance between platform track turnout switch to farthest station crossover switch is 3,000 feet.	Station crossovers located approximately 5,875 feet from turnouts. The crossover is located less than 2 miles from the phase break at West Park TPSS. Furthermore, there is an overlapping vertical curve in a spiral transition.	The horizontal geometry associated with the physical constraints in this general area do not allow for the station crossovers to be placed directly adjacent to the station tracks. Placing the station tracks as close as geometrically possible then exceeds the 2-mile minimum spacing from the phase break at West Park TPSS to the crossover home signal. To physically provide enough tangent length vertically as well as horizontally for the crossover, a vertical curve had to be placed within a spiral transition to maintain a reasonable structure height.	
22	Station7207+20	TM 2.10.10 29 Feb 12, Draft Revision R1 Clause 2.1.2, and various other clauses	Preliminary track design philosophy per TM 2.1.5: Track Design [9] is to avoid rail expansion joints, if practical. Thus, for preliminary design, the maximum limit from the fixed point to the free point of structure (i.e., structural thermal unit) is 330 feet.	At the request of the PMT, a truss span has been used in conjunction with a straddle bent to cross the BNSF tracks adjacent to Bakersfield High School.	Use of shorter spans in conjunction with straddle bents would require the demolition of some of the Bakersfield High School buildings, which are next to the railway tracks. The combination of a long-span truss and the straddle bents avoids taking this locally sensitive property.	

No.	Location/ Station	Design Criteria Reference	Minimum Or Exceptional Standard Requiring Deviation	Variance Request	Constraint/ Justification	Approval Date
23	Station7210+78	TM - January 28, 2013, EMT to RCs DRAFT Maintenance Access Requirements	A 15-foot-wide maintenance access measured from outside edge of structure, typically the superstructure drip line but could be column or foundation for irregular structures (i.e. straddle bents) along the length of the aerial structure. Minimum requirement is aerial structure (10 foot minimum); at-grade (10 foot minimum).	Minimum 4.8-foot maintenance access available south of the straddle bent foundation.	Any addition to the right-of-way required for maintenance would impact Bakersfield High School and its access on G Street.	
24	Station7251+95	TM 2.1.3 Directive Drawings Typical Interlock Schematics - February 25, 2010, Rev 0, Drawing Interlock A	Distance between platform track turnout and centerline of station platform is 3,000 feet for 110-mph turnouts.	80-mph turnouts on west of station approach located approximately 1,780 feet from the platform centerline.	The B3 alignment mitigates the following impacts: (1) avoids the Bakersfield High School Industrial Arts Building; (2) avoids several churches in East Bakersfield; and (3) minimizes community impacts in East Bakersfield. The B3 alignment accomplishes these criteria while still allowing a station campus to be placed west of Union Ave and allowing the 4-track section to be dropped prior to the back-to-back curvature for cost containment.	
25	Station7349+16	TM 2.1.3 Directive Drawings Typical Interlock Schematics - February 25, 2010, Rev 0, Drawing Interlock A	Maximum distance between platform track turnout switch to farthest station crossover switch is 3,000 feet.	Station crossovers located approximately 6,855 feet from turnouts.	Crossovers are located as close as possible to the station location within the constraints of the horizontal and vertical geometry.	

No.	Location/ Station	Design Criteria Reference	Minimum Or Exceptional Standard Requiring Deviation	Variance Request	Constraint/ Justification	Approval Date
26	Station7352+57	TM 1.1.21 Typical Cross-Sections for 15% Design - August 19, 2013, Rev 1	15-foot-wide (desirable), 10-foot-wide (minimum) maintenance access measured from outside edge of structure, typically the superstructure drip line but could be column or foundation for irregular structures (i.e., straddle bents) along the length of the aerial structure, and 15-foot-wide (desirable), 10-foot-wide (minimum) clearance around the columns and foundations should be maintained to provide access to the columns and the foundations.	The HSR right-of-way is curtailed by the UPRR right-of-way at the location of the straddle bent east foundation.	The foundation needs to be placed within the UPRR right-of-way as the column is located between diverging tracks.	
27	Station7394+50	TM - January 28, 2013, EMT to RCs DRAFT Maintenance Access Requirements	Minimum requirement for access to foundations is 10-foot clearance	Provision of less than 10 feet of clearance around foundation.	At one corner, the foundation would not have 10 feet of clearance from the canal.	
28	Stations991+50, 1836+00 to 1859+00, and 4369+00 to 4396+00	TM 1.1.21 Typical Cross-Sections for 15% Design - August 19, 2013, Rev 1	Minimum cross-section widths at interlocking houses, radio sites, and traction power facilities.	Allow the use of a short retaining wall on embankment cross-sections to provide sufficient clearance for the maintenance access road.	Footprint is not available at all locations to accommodate the full cross-section width. Additional footprint not possible due to proximity of the BNSF right-of-way in some cases.	

16.2 Third-Party Design Variances

Table 16.2-1 lists third-party design variances that would be required.

Table 16.2-1
Third-Party Design Variances

No.	Roadway / Location	Design Criteria Reference	Minimum or Exceptional Standard Requiring Deviation	Variance Request	Constraint / Justification	Approval Date
1	Lincoln Ave Overcrossing Station633+47.39	Improvement Standards for Fresno County Design Speed	65-mph design speed	Reduce design speed from 65 mph to 55 mph.	Property impacts along intersecting roads.	
2	Adams Ave Overcrossing Station686+26.09	Improvement Standards for Fresno County Design Speed	65-mph design speed	Reduce design speed from 65 mph to 55 mph.	Property impacts along intersecting roads.	
3	South Ave Overcrossing Station739+08.24	Improvement Standards for Fresno County Design Speed	65-mph design speed	Reduce design speed from 65 mph to 55 mph.	Property impacts along intersecting roads.	
4	Manning Ave Overcrossing Station791+99.94	Improvement Standards for Fresno County Design Speed	65-mph design speed	Reduce design speed from 65 mph to 55 mph.	Property impacts along intersecting roads	
5	Corcoran Highway intersection with SR 43	Caltrans HDM	Advisory Standard - 403.3 Angle of Intersection	The proposed work on Corcoran Highway conforms prior to the intersection with SR 43. The request is to maintain the existing intersection angle.	Realignment of this leg of the intersection would have additional property impacts and would require the realignment/reconstruction of the western leg of the intersection that is not currently impacted by the project.	

No.	Roadway / Location	Design Criteria Reference	Minimum or Exceptional Standard Requiring Deviation	Variance Request	Constraint / Justification	Approval Date
6	Whitley Ave/SR 137 intersection with SR 43	Caltrans HDM	Advisory Standard - 403.3 Angle of Intersection	The proposed work on Whitley Ave/SR 137 conforms at the intersection with SR 43. The request is to maintain the existing intersection angle.	Realignment of this leg of the intersection would have additional property impacts and would require the realignment/reconstruction of the western leg of the intersection that is not currently impacted by the project.	
7	HSR crossover Structure	Caltrans HDM	Advisory Standard – HDM 309.1 (4) High-Speed Rail Clearances	HSR Columns parallel to SHS with less than 52-foot separation from SHS facility.	It is impractical to provide a span with sufficient length to obtain required horizontal offset. Appropriate protection would be provided (barrier, etc.)	

Section 17.0

Design and Construction Permits

17.0 Design and Construction Permits

The April 2013 version of TM 0.1 calls for inclusion in the DBR of a "preliminary listing of the anticipated design/construction permits that may be required from regulatory, resource, state, and federal agencies." Therefore, this section now includes a summary of the environmental permits that have the potential to influence the 15% preliminary design, in addition to a preliminary list of construction permits that could be required for the FB Section.

17.1 Influence of Environmental Permits and Approvals on 15% Design

The following environmental permits and approvals influenced the 15% design effort:

- Federal Clean Water Act Section 404 permit from U.S. Army Corps of Engineers (USACE)
- Consultation with U.S. Fish and Wildlife Service (USFWS) under Section 7 of the federal Endangered Species Act
- Rivers and Harbors Act Section 14 (408) permission from USACE

The regulatory requirements of these permits and approvals and the way in which they influenced the 15% design are discussed below.

Additional agency consultations and agreements also affected 15% design, including requirements under Section 106 of the National Historic Preservation Act and Sections 4(f) and 6(f) of the Department of Transportation Act. These and other such statutory consultations and agreements, though not permits *per se*, are listed in Table 17.3-1.

404 Permits

Section 404 permitting or authorization is required from USACE for any activity that would result in the discharge of fill material (including re-depositing dredged material but not including incidental fallback) into waters of the United States. The Fresno to Bakersfield Section requires an individual 404 permit, which means that USACE may only permit the Least Environmentally Damaging Practicable Alternative (LEDPA) as determined through a 404(b)(1) alternatives analysis.

Project alternatives were identified and developed based on the Section 404(b)(1) *Guidelines for Specification of Disposal Sites for Dredged or Fill Material* (40 CFR 230). Those guidelines require an applicant for a Section 404 permit to demonstrate first that all reasonable efforts have been made to avoid the discharge of fill material into waters of the United States and second where avoidance is not possible, that all reasonable measures have been taken to minimize the discharge of fill material.

Early in the alternatives development process, the BNSF Alternative north of Corcoran (K2) was modified to avoid the Tulare Lakebed Mitigation Site. The Allensworth Bypass Alternative (A1) was developed to avoid waters of the United States located along the BNSF right of way in the Allensworth area (A2). Following identification of alignment alternatives, design efforts were made to minimize the width of the right of way of each alternative where it would cross waters of the United States.

Section 7 Consultation

Section 7 of the Endangered Species Act states that, all federal agencies must ensure that their actions do not jeopardize the continued existence of a listed species or destroy or adversely modify critical habitat. Consultation under Section 7 can result in an incidental take permit for

activities that would not jeopardize the continued existence of a protected species. For take authorization to be granted, a project proponent must submit a plan that, among other things, outlines the steps that will be taken to minimize and mitigate any adverse effects on protected species.

The Fresno to Bakersfield Section crosses several areas that are identified as migratory corridors for a variety of species, including species protected under the Endangered Species Act such as the San Joaquin kit fox. Where HSR alignment alternatives cross these corridors at grade, they are significant barriers to wildlife migration. The engineering team, in consultation with local wildlife experts, designed wildlife crossings in these areas to minimize potential impacts to wildlife migration. Further, on segments of the K4 and C2 alignments north of Corcoran, specific mitigation measures would minimize impacts on an area of potential habitat for the California tiger salamander. Details of the mitigation measures are defined in Section 5.3.4.2.

Section 408 Permission

In accordance with Section 14 of the Rivers and Harbors Act (33 U.S.C. 408), USACE must approve any proposed modification that affects a federal flood control project. A Section 408 permit would be required if the project encroaches on a federal facility or if project construction modifies a federal levee. Encroachments include levee systems and waterways regulated by the USACE. A Section 208.10 permit would be required where the project crosses the right of way of a federal flood control facility or interferes with its operation or maintenance without changing the system's structural geometry or hydraulic capacity.

The Central Valley Flood Protection Board (CVFPB), formerly the California Reclamation Board, administers Section 208.10 in the Central Valley. CVFPB administers permits for encroachments on state and state/federal flood control projects. USACE provides a concurrent review of the technical aspects of encroachment permit applications and provides to CVFPB a list of technical requirements to satisfy USACE responsibilities under Section 208.10.

The Kings River Conservation District (KRCD) maintains several levees on the Kings River system as part of a federal flood project. These include the north and south banks of Cole Slough and the north bank of Dutch John Cut. Encroachments on these levees are subject to approval by CVFPB, KRCD, and USACE.

The Authority's design for the BNSF Alternative crossing the Kings River system provided in the Revised DEIR/Supplemental DEIS, called for 3 feet of clearance over the levees. This was not acceptable to KRCD because it would not allow sufficient clearance for levee maintenance and emergency repairs. Without approval from KRCD, permission for the HSR crossing would likely not be provided by the CVFPB or USACE. The design of the crossing was modified for the Final EIR/EIS, in consultation with KRCD, to provide 18 feet of clearance over the levees.

17.2 Influence of Environmental Permits and Approvals on Final Engineering Design

The FRA and Authority has received a Biological Opinion (BO) from the USFWS on the Fresno to Bakersfield Section and expects to obtain approved Treatment Plans for cultural resources under Section 106 of the federal Historic Preservation Act prior to initiating final engineering design for the project. The BO and Treatment Plans contain project conditions that may influence final engineering design.

The Authority has submitted or will submit applications for the following permits prior to initiating final engineering design:

USACE Section 404 permit

- California State Water Resources Control Board (SWRCB) 401 Water Quality Certification
- California Department of Fish and Wildlife (CDFW) 1602 Streambed Alteration Agreement
- CDFW Section 2081 incidental take permit

These permits will be finalized during completion of the project design, and must be approved before the start of construction. All of the permits will contain project conditions that may influence final design.

17.3 Construction Permits

Table 17.3-1 provides a list of permits, approvals, consultations, and agreements that may need to be in place prior to construction.

Table 17.3-1
Preliminary List of Design and Construction Permits, Consultations, and Requirements[2]

No.	Jurisdictional Agency	Code, Reg, Std or Guideline	Notes
Federal Agencies			
1	Federal Railroad Administration	NEPA Department of Transportation Act Sections 4(f) and 6(f) 49 CFR Part 200-299	• Lead federal agency responsible for implementation of NEPA, and coordination with other federal agencies. • Responsible for coordination with federally recognized tribes under NHPA Section 106. • Responsible for use determinations for project impacts on properties protected under Section 4(f) or 6(f). Project designed to avoid use wherever feasible.
2	Advisory Council on Historic Preservation	NHPA Section 106	Oversees compliance with NHPA; elected to participate as a signatory to the FB Section Memorandum of Agreement, per Section 106.
3	Department of Homeland Security	N/A	N/A
4	Federal Aviation Administration	14 CFR 77.24 (aka Part 77)	Air space clearance for air craft facilities (e.g., landing strips, heliports)
5	Federal Communications Commission	47 CFR 17.7	Manages antenna structure registration, including for stand-alone radio sites for HSR - requires TOWAIR analysis.
6	Federal Emergency Management Agency	N/A	N/A
7	National Marine Fisheries Service	Federal Endangered Species Act	The FRA has determined that there is no jurisdiction for the National Marine Fisheries Service in the FB Section.

[2] This table is based on information available at the 15% level of design. Not all listed entities may be affected by
construction or operation of the HSR, and other entities not listed may be affected. This list is not intended as a basis for construction planning. The Authority and/or contractors will be responsible for identifying and complying with all applicable federal, state, and local requirements.

No.	Jurisdictional Agency	Code, Reg, Std or Guideline	Notes
8	Natural Resources Conservation Service	NRCS-CPA-106	N/A
9	U.S. Army Corps of Engineering	• Federal Clean Water Act, Section 404 (Nationwide Permit and Individual Permit) • Rivers and Harbors Act, Section 408	• Oversees and issues permits governing projects that dredge or fill waters of the U.S. • Makes major or minor Section 408 determinations for projects that affect flow in waterways.
10	U.S. Environmental Protection Agency, Region 9	Federal Clean Air Act, Section 176(c)(4)	Oversees completion of the United States Environmental Protection Agency General Conformity Determination process. Party to the Checkpoint C MOA among Authority, FRA, USACE, and EPA.
11	U.S. Fish and Wildlife Service, Region 8	Federal Endangered Species Act	Implementation of avoidance and minimization measures to avoid take of the species. Otherwise requires preparation of a Biological Assessment and request incidental "take" authorization under Section 7 of the federal Endangered Species Act. Initiation of consultation to be requested by FRA. The U.S. Fish and Wildlife Service prepared and issued a Biological Opinion in April 2014.
State Agencies			
12	California High-Speed Rail Authority	CEQA	Lead state agency responsible for implementation of CEQA for the HSR System and responsible for coordination with other state and federal agencies.
13	California Air Resources Board	• Indirect Source Review (ISR) • Voluntary Emissions Reduction Agreement (VERA)	• Responsible for completing project ISR. • Administers VERA program
14	California Department of Conservation	Williamson Act Properties Government Code §§51290 - 51295 and 51296.6	Requires notification of project effects on Williamson Act contracts.

No.	Jurisdictional Agency	Code, Reg, Std or Guideline	Notes
15	California Department of Fish and Wildlife, Region 4	• California Endangered Species Act (CESA) • California Fish and Game Code Section 2081 – Incidental Take Permit • Title 14 Memorandum of Agreement • California Fish and Game Code Section 1602 – Streambed Alteration Agreement Programmatic Permit	• Administers CESA • Reviews applications and issues Incidental Take Permit and incidental "take" authorization. Reviews applications and issues Streambed Alteration Agreement programmatic permits
16	Department of Transportation, District 6	Highway Design Manual	Prepare project reports and fact sheets for intersection of HSR with state highway facilities; obtain encroachment permits for activity within Caltrans right of way.
17	California Public Utilities Commission	• General Orders • Application to Construct	• Establishes design and safety requirements for electric utilities • Approves construction of new/modification of existing high-voltage power lines
18	California State Water Resources Control Board / Central Valley Regional Water Quality Control Board	• Federal Clean Water Act: Section 401 - State Water Quality Certification • Section 402 – NPDES Permit (Construction General Permit and Municipal Separate Storm Sewer Permit • Porter Cologne Act, Central Valley Basin Plan	• In partnership with the Central Valley Regional Water Quality Control Board, SWRCB issues Water Quality Certification's • Administers National Pollutant Discharge Elimination (NPDES) permitting for discharge of stormwater from construction sites and/or impacts on the beneficial uses of state jurisdictional waters. • Issues orders and waste discharge requirements for effluent discharge surface or groundwater.

No.	Jurisdictional Agency	Code, Reg, Std or Guideline	Notes
19	Central Valley Flood Protection Board	• Section 208 Water Quality Management • Encroachment Permits	• Administers Clean Water Act Section 208 compliance in conjunction with USACE • Issues encroachment permits for projects encroaching into state jurisdictional waters
20	CalEPA Department of Toxic Substances Control	California Health and Safety Code	Regulates hazardous and toxic substances and oversees cleanup, management, transport, treatment and disposal of contaminated and hazardous materials and coordinate disruption of remediation systems at known contaminated sites and coordinate disposal of hazardous or toxic substances
21	Native American Heritage Commission	California Public Resources Code (PRC) 5097.98	Must be notified in the event human remains are encountered during construction.
22	Office of the State Fire Marshal	NFPA 101	Oversees development and enforcement of fire prevention engineering.

No.	Jurisdictional Agency	Code, Reg, Std or Guideline	Notes
23	State Historic Preservation Office	• National Historic Preservation Act (NHPA) • CEQA	• Ensures that the compliance obligations under Section 106 of the NHPA are followed, which requires the lead federal agency of an undertaking to consider the effects of their actions on the properties that are listed or may be eligible for listing in the National Register of Historic Places. Requires preparation of a Section 106 report that evaluates the significance of archaeological, historical, and architectural properties, and develops treatment plans in accordance with the Secretary of the Interior Standards for Treatment of Historic Properties and Cultural Landscapes. To be executed through a programmatic agreement and a memorandum of agreement with the project proponents and other consulting or concurring parties. Oversees Native American consultations. • Manages CEQA compliance for historical resources.
24	California Department of Parks and Recreation	Proposition 1A, 1974	• Administers 280 state park units, including Colonel Allensworth State Historic Park between the BNSF and Allensworth Bypass Alternatives. • Oversees administration of federal and state historic preservation programs.

No.	Jurisdictional Agency	Code, Reg, Std or Guideline	Notes
Local Agencies			
25	Cities of Bakersfield, Corcoran, Fresno, Hanford, Shafter, and Wasco	City ordinances and General Plans	Implement city ordinances and manages development in accordance with the General Plan, including; • Encroachment permits • Demolition permits • Construction Management Plan • Transportation Management Plans • Maintenance Agreements • Noise restrictions • Water connection permit • Wastewater discharge permits • Must concur with FRA use determinations for city-owned Section 4(f) and 6(f) properties
26	Counties of Fresno, Kern, Kings, and Tulare	• County code and master plans • Williamson Act	The counties implement county ordinances and manage development in accordance with the county Master Plan, including; • Encroachment permits • Easement abandonment permits • Well permits for wells, piezometers, and exploratory borings that intersect the saturated zone. • Transportation Management Plans • Noise restrictions • Maintenance agreements • Wastewater discharge permits • Modify contracts for any affected Williamson Act properties.

No.	Jurisdictional Agency	Code, Reg, Std or Guideline	Notes
27	San Joaquin Valley Air Pollution Control District	• Rule 9510 Indirect Source Review (ISR) Rule 201, General Permit Requirements Rule 403, Fugitive Dust Requirements Rule 442, Agriculture Coatings Requirements Rule 902, Asbestos Requirements • Federal Clean Air Act, Title V; San Joaquin Valley Unified Air Pollution Control District (SJVAPCD) Regulation II	• Must comply with Rule 9510 ISR mitigation requirements. • Permits for stationary-source emissions sources associated with the Fresno, Hanford, and Bakersfield stations and maintenance facilities located within SJVAPCD jurisdiction.

No.	Jurisdictional Agency	Code, Reg, Std or Guideline	Notes
Water Agencies			
28	• Alpaugh Irrigation District • Angiola Water District • Arvin-Edison Water Storage District • Atwell Island Water District • California Water Service Company • Consolidated Irrigation District • Corcoran Irrigation District • Fresno Irrigation District • Kaweah Delta Water Conservation District • Kern County Water Agency Improvement District #4 • Kings River Conservation District • Kings County Water District • Lakeside Irrigation Water District • Liberty Water District • Lower Tule River Irrigation District • North Kern Water Storage District • Pixley Irrigation District • Pond Poso Improvement District • Rosedale Ranch Improvement District • Rosedale-Rio Bravo Water Storage District • Semitropic Water Storage District • Shafter-Wasco Irrigation District • Vaughn Water Company	License Agreements	• Encroachment permits • Maintenance agreements • Operations agreements (e.g., minimum flow requirements) • Seasonal restrictions on construction

No.	Jurisdictional Agency	Code, Reg, Std or Guideline	Notes
Other Agencies			
29	BNSF Railway Company	• Operational guidelines • Safety controls	• Encroachment permits • Operations coordination • Responsible for design and construction of relocations
30	San Joaquin Valley Rail Committee	N/A	N/A
31	Underground Service Alert (USA)	• California Law California Business Professions Code Section 7110, page 22 California • Government Code (CGC) 4216 requirements, pages 23 - 31	Must call (800) 227-2600 2 working days or up to 14 calendar days prior to digging.
32	Union Pacific Railroad	• Operational guidelines • Safety controls	• Encroachment permits • Operations coordination • Responsible for design and construction of relocations
33	Utility owners (electric, gas, pipelines, etc.)	Various	Must coordinate relocations and service interruptions

Section 18.0

Special and Unusual Conditions

18.0 Special and Unusual Conditions

No special or unusual conditions beyond those described in the previous sections have been identified in the FB Section.

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Section 19.0

Sustainability Checklist for Public Facilities

19.0 Sustainability Checklist for Public Facilities

The Sustainability Checklist for Public Facilities will not be addressed in this DBR.

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Section 20.0

References

20.0 References

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20.1 Technical Memoranda

The following TMs apply to the 15% Design:

TM Title	Current Revision	Date
TM 0.0a Design Terms and Acronyms	R1	9/05/08
TM 0.1 15% Design Scope	R3*	12/24/13
TM 0.3 CHSTS Basis of Design Report	R3	6/21/13
TM 0.5 Coordination with Caltrans	R1	12/30/09
TM 0.7 Design Submittal Protocol	R2	8/30/10
TM 1.1.0 Conceptual Design Criteria for Alignments and Platform	R0	3/19/07
TM 1.1.1 Codes, Regulations, Design Standards, and Guidelines	R0	7/10/09
TM 1.1.2 Design Life	R0	6/8/09
TM 1.1.4 Engineering Mapping and Surveys	R1	3/16/10
TM 1.1.5 CADD Guidelines	R2	10/5/09
TM 1.1.8 Proposed Methodology for Demarcation of Territorial	R0	9/16/09

TM Title	Current Revision	Date
Subdivisions and Milepost Numerics		
TM 1.1.10 High-Speed Equipment Structure Gauges	RO	3/24/10
TM 1.1.18 Design Variance Guidelines	R1*	3/14/11
TM 1.1.19 15% Capital Cost Method	R1	1/11/11
TM 1.1.21 Typical Cross Sections for 15% Design	R1*	8/19/13
TM 2.1.2 Alignment Design Standards for High-Speed Train Operation	R0	4/8/09
TM 2.1.3 Turnouts and Station Tracks	R0	6/29/09
TM 2.1.7 Intrusion Protection	R1	06/21/13
TM 2.1.8 Turnouts and Yard Tracks	R0	7/17/09
TM 2.2.2 Station Program Design Guidelines (Policy)	R1	06/07/11
TM 2.2.3 High-Speed Train Passenger Station Site Design Guidelines	R0	4/10/09
TM 2.2.4 Station Platform Geometric Design	R1	7/7/10
TM 2.3.2 Structure Design Loads	R2	7/08/11
TM 2.3.3 Design Guidelines for High-Speed Train Aerial Structures	R0	6/2/09
TM 2.5.1 Structure Design of Surface Facilities and Buildings	R0	6/10/10
TM 2.6.5 Hydraulics and Hydrology Design Guidelines	R1	7/27/11
TM 2.6.7 Earthwork and Track Bed Design Guidelines	R0	7/23/09
TM 2.7.4 Utilities Requirements for 15% Design	R0	11/20/08
TM 2.8.1 Safety and Security Design Requirements	R0	2/19/13
TM 2.8.2 Access Control for HSR ROW and Facilities	R0	10/11/10
TM 2.9.1 Geotechnical Investigation Guidelines	R1	7/27/11
TM 2.9.2 Geotech Reports Preparation Guidelines	R1	7/27/11
TM 2.9.3 Geologic and Seismic Hazard Analysis Guidelines	R1	7/27/11
TM 2.9.6 Interim Ground Motion	R0	3/11/10
TM 2.9.10 Geotechnical Design Guidelines	R1	7/18/11
TM 2.10.4 Interim Seismic Design Criteria	R1	7/8/11
TM 2.10.5 15% Seismic Design Benchmark	R0	3/29/10
TM 2.10.6 Fault Rupture Analysis and Mitigation	R0	6/11/10
TM 2.10.10 Track Structure Interaction	R1**	12/10/13
TM 3.1.1.3 Traction Power Facilities General Standardization Requirements	R2	6/10/10
TM 3.3.2 ATC Site Requirements	R0	6/28/10
TM 3.4.1 Communications System General Reqts	R0	9/27/10

TM Title	Current Revision	Date
TM 3.4.2 Communications Systems Site Requirements	R0	7/7/10
TM 5.3 Summary Description of Requirements and Guidelines for: Heavy Maintenance Facility, Terminal Layup/Storage & Maintenance Facilities, and Right-of-Way Maintenance Facilities	R0	8/05/09

* Some elements of the latest TM versions have not been incorporated into the design as noted in this report.

**Latest revision of this TM has not been incorporated into the design or discussed and agreed with the Authority.

The following supplemental guidance applies to the 15% Design:

Guidance Title	Date
Memo – "Guidance – Location of Phase Breaks (Associated with Substation and Switching Stations)"	3/25/10
Notice to Designers 06 – Requirement for Identification of Standalone Radio Sites at 2.5 mile Intervals	8/25/11

Appendix A

Preferred Alignment Key Maps

Below is a list of preferred alignment key maps provided in the DBR:

- F1 Alignment - Fresno
- M Alignment – Monmouth Subsection
- H Alignment – Hanford Subsection
- K4 Alignment - Kaweah Subsection
- C2 Alignment – Corcoran Bypass
- P Alignment – Pixley Subsection
- A1 Alignment – Allensworth Bypass Subsection
- L1 Alignment – Poso Creek
- WS1 Alignment – Through Wasco Shafter
- B3 Alignment – Bakersfield Urban Hybrid Alternative

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REV	DATE	BY	CHK	APP	DESCRIPTION

DESIGNED BY A. POLING
DRAWN BY P. TONKIN
CHECKED BY K. SEYMOUR
IN CHARGE R. COFFIN
DATE 12/31/13

RECORD SET 15% DESIGN SUBMISSION - NOT FOR CONSTRUCTION

URS | HMM | ARUP
CALIFORNIA HIGH-SPEED TRAIN

CALIFORNIA HIGH-SPEED RAIL AUTHORITY

CALIFORNIA HIGH-SPEED TRAIN PROJECT
FRESNO TO BAKERSFIELD

FRESNO SUBSECTION
ALIGNMENT F1
STA. 257+24 TO 627+07
KEY MAP

CONTRACT NO. HSR 06-0003
DRAWING NO. CB1650
SCALE AS SHOWN
SHEET NO. 1 OF 24

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URS | HMM | ARUP
CALIFORNIA HIGH-SPEED TRAIN

CALIFORNIA
HIGH-SPEED RAIL AUTHORITY

CALIFORNIA HIGH-SPEED TRAIN PROJECT
FRESNO TO BAKERSFIELD
MONMOUTH SUBSECTION
ALIGNMENT M
STA. 630+26 TO 1065+07
KEY MAP

CONTRACT NO. HSR 06-0003
DRAWING NO. CB1790
SCALE AS SHOWN
SHEET NO. 1 OF 11

RFP No. HSR 14-32 – INITIAL RELEASE - 05/27/2015

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URS | HMM | ARUP
CALIFORNIA HIGH-SPEED TRAIN

CALIFORNIA
HIGH-SPEED RAIL AUTHORITY

CALIFORNIA HIGH-SPEED TRAIN PROJECT
FRESNO TO BAKERSFIELD
HANFORD SUBSECTION
ALIGNMENT H
STA. 1065+07 TO 2144+63
KEY MAP

CONTRACT NO. HSR 06-0003
DRAWING NO. CB1800
SCALE AS SHOWN
SHEET NO. 1 OF 31

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URS | HMM | ARUP
CALIFORNIA HIGH-SPEED TRAIN

CALIFORNIA
HIGH-SPEED RAIL AUTHORITY

CALIFORNIA HIGH-SPEED TRAIN PROJECT
FRESNO TO BAKERSFIELD

KAWEAH SUBSECTION
ALIGNMENT K4
STA. 2074+96 TO 2598+60
KEY MAP

CONTRACT NO. HSR 06-0003
DRAWING NO. CB1130
SCALE AS SHOWN
SHEET NO. 1 OF 15

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URS | HMM | ARUP
CALIFORNIA HIGH-SPEED TRAIN

CALIFORNIA
HIGH-SPEED RAIL AUTHORITY

CALIFORNIA HIGH-SPEED TRAIN PROJECT
FRESNO TO BAKERSFIELD

CORCORAN BYPASS SUBSECTION
ALIGNMENT C2
STA. 2954+81 TO 3096+00
KEY MAP

CONTRACT NO. HSR 06-0003
DRAWING NO. CB1850
SCALE AS SHOWN
SHEET NO. 1 OF 16

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CALIFORNIA HIGH-SPEED TRAIN

CALIFORNIA HIGH-SPEED RAIL AUTHORITY

CALIFORNIA HIGH-SPEED TRAIN PROJECT
FRESNO TO BAKERSFIELD
PIXLEY SUBSECTION
ALIGNMENT P
STA. 3096+00 TO 3459+25
KEY MAP

CONTRACT NO. HSR 06-0003
DRAWING NO. CB1300
SCALE AS SHOWN
SHEET NO. 1 OF 9

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LEGEND

EXISTING FREIGHT RAILROAD

PROPOSED CHST

3000 0 3000 6000

1"=3000'

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DATE 12/31/13

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URS | HMM | ARUP
California High-Speed Train

CALIFORNIA HIGH-SPEED RAIL AUTHORITY

CALIFORNIA HIGH-SPEED TRAIN PROJECT
FRESNO TO BAKERSFIELD
ALLENSWORTH BYPASS SUBSECTION
ALIGNMENT A1
STA. 3919+50 TO 4925+51
KEY MAP

CONTRACT NO. HSR 06-0003
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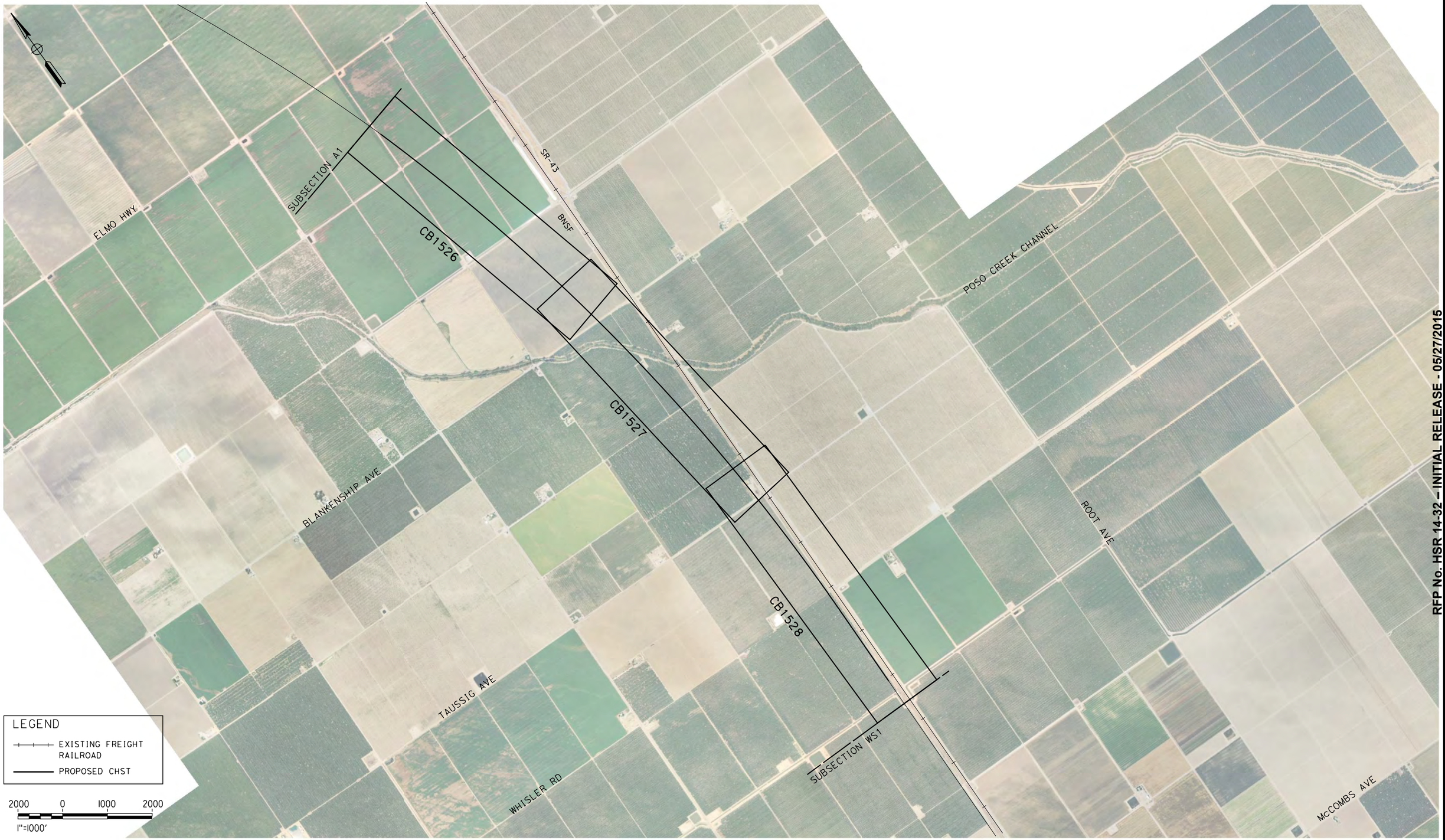

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URS | HMM | ARUP
CALIFORNIA HIGH-SPEED TRAIN

CALIFORNIA
HIGH-SPEED RAIL AUTHORITY

CALIFORNIA HIGH-SPEED TRAIN PROJECT
FRESNO TO BAKERSFIELD
POSO CREEK SUBSECTION
ALIGNMENT L1
STA. 5154+50 TO 5322+33
KEY MAP

CONTRACT NO. HSR 06-0003
DRAWING NO. CB1525
SCALE AS SHOWN
SHEET NO. 1 OF 6

RFP No. HSR 14-32 – INITIAL RELEASE - 05/27/2015

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URS | HMM | ARUP
CALIFORNIA HIGH-SPEED TRAIN

CALIFORNIA HIGH-SPEED RAIL AUTHORITY

CALIFORNIA HIGH-SPEED TRAIN PROJECT
FRESNO TO BAKERSFIELD
THROUGH WASCO-SHAFTER SUBSECTION
ALIGNMENT WS1
STA. 5422+50 TO 6511+99
KEYPLAN

CONTRACT NO. HSR-06-0003
DRAWING NO. CB1448
SCALE AS SHOWN
SHEET NO. 1 OF 35

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CALIFORNIA HIGH-SPEED TRAIN

CALIFORNIA HIGH-SPEED RAIL AUTHORITY

CALIFORNIA HIGH-SPEED TRAIN PROJECT
FRESNO TO BAKERSFIELD
BAKERSFIELD URBAN SUBSECTION
ALIGNMENT B3
STA. 6799+52.58 TO 7430+49.81
KEY MAP

CONTRACT NO. HSR 06-0003
DRAWING NO. CB0830
SCALE AS SHOWN
SHEET NO. 1 OF 31